

ATP 6-02.70

TECHNIQUES FOR SPECTRUM MANAGEMENT OPERATIONS

DECEMBER 2015

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***This publication supersedes FM 6-02.70, dated 20 May 2010.**

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Preface

ATP 6-02.70, *Techniques for Spectrum Management Operations*, establishes Army doctrine for Army spectrum management operations (SMO). This publication provides overarching doctrinal guidance to Army spectrum users and describes how spectrum managers support commanders through the warfighting functions, the military decisionmaking process, and the common operational picture (COP). This ATP provides technical descriptions of the SMO tool's capabilities and compatibility with other tools, as well as how to use these tools in the execution of spectrum management operations in unified land operations.

The principal audience for ATP 6-02.70 is Army commanders, leaders and staffs at all levels, members of the Army profession and Department of Defense (DOD) contractors whose duties involve spectrum management operations. Commanders and staffs of Army headquarters serving as joint task force or multinational headquarters should also refer to applicable joint or multinational doctrine concerning the range of military operations and joint or multinational forces. Trainers and educators throughout the Army will also use this publication.

Commanders, staffs, and subordinates ensure their decisions and actions comply with applicable U.S., international, and, in some cases, host-nation laws and regulations. Commanders at all levels ensure their Soldiers operate in accordance with the law of war and the rules of engagement. (See FM 27-10)

ATP 6-02.70 uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. Terms for which this ATP is the proponent are marked with an asterisk (*) in the glossary. Definitions for which ATP 6-02.70 is the proponent publication are boldfaced in the text. For other definitions shown in the text, the term is italicized and the number of the proponent publication follows the definition.

This publication applies to the Active Army, Army National Guard/Army National Guard of the United States, and United States Army Reserve unless otherwise stated.

The proponent of ATP 6-02.70 is the U.S. Army Cyber Center of Excellence. The preparing agency is the Cyber Center of Excellence Doctrine Branch, United States Army Cyber Center of Excellence. Send comments and recommendations on a DA Form 2028 (Recommended Changes to Publications and Blank Forms) to Commander, U.S. Army Cyber Center of Excellence and Fort Gordon, ATTN: ATZH-DT (ATP 6-02.70), 506 Chamberlain Avenue, Fort Gordon, Georgia 30905-5735, or by e-mail to usarmy.gordon.cybercoe.mbx.gord-fg-doctrine@mail.mil.

Introduction

ATP 6-02.70, *Techniques for Spectrum Management Operations* is the Army's doctrine for spectrum management operations in support of unified land operations. This publication replaces FM 6-02.70, *Army Electromagnetic Spectrum Operations* and introduces the subject in the form of an Army techniques publication. Aligned with FM 6-02, *Signal Support to Operations* and FM 3-38, *Cyber Electromagnetic Activities*, this publication provides the Army's current doctrine with regard to spectrum management operations.

ATP 6-02.70 contains updated doctrinal information and makes numerous changes to the information found in FM 6-02.70. The most significant change is the introduction and use of the acronym SMO (spectrum management operations), introduced in FM 6-02, *Signal Support to Operations*. This change provides less confusion to Soldiers and legitimizes the acronym already in use within the spectrum community. The content in ATP 6-02.70 aligns with FM 6-02.70 however, changes to current Army doctrine and the Army's emphasis on cyber electromagnetic activities prompted new terminology.

Throughout this publication, when using the term spectrum, this refers to the radio frequency spectrum of the electromagnetic spectrum. The electromagnetic spectrum encompasses the entire range of frequencies while the term spectrum refers to the part of the electromagnetic spectrum that is transmitted and received by various types of equipment.

This publication contains five chapters and five appendixes—

Chapter 1 provides an overview of spectrum management operations, states the objectives, and describes spectrum management operations core functions.

Chapter 2 discusses spectrum management operations support and input to the military decisionmaking process and briefly describes the common operational picture. Spectrum managers provide support at every step of the military decisionmaking process.

Chapter 3 links Army spectrum management operations to the warfighting functions, describes how spectrum management operations support, and enables commander's efforts as they exercise mission command.

Chapter 4 describes spectrum information and products necessary at the corps and joint task force levels. Spectrum managers are located within three organizations in a joint task force: the joint frequency management office, the joint spectrum management element, and the cyber electromagnetic activities (CEMA) element. These agencies have a wide variety of inputs, collaboration, and products. This chapter shows input and products from different joint agencies displayed in table format.

Chapter 5 is an overview of the many useful tools spectrum managers use in support of unified land operations. These tools operate within a network-centric environment using shared databases within the spectrum community.

Finally, the ATP contains five appendixes containing standard tasks and steps that describe spectrum management operations related tasks.

Appendix A describes the electromagnetic spectrum manager task list and each supporting sub-tasks. This appendix also contains flow charts that show the collaboration process between electromagnetic spectrum managers and the CEMA element.

Appendix B provides spectrum management operations tool capabilities and compatibility between software systems. These net-centric systems are in many cases linked and accessible through Nonsecure Internet Protocol Router Network (NIPRNET) and SECRET Internet Protocol Router Network (SIPRNET).

Appendix C provides basic electromagnetic physics and underlying principles of the electromagnetic spectrum.

Appendix D introduces the 12-step spectrum management lifecycle. This process serves as a guide to follow in establishing a functional and efficient spectrum management program. The lifecycle encompasses the complete process of providing spectrum management operations support to the commander and is applicable to all spectrum managers regardless of duty location. The Army spectrum management lifecycle mirrors the joint task force lifecycle adapted for the Army spectrum manager.

Appendix E provides the reader with an overview of the military time zone designators. This appendix describes time zones for civilian and military uses. The chart, included in this appendix, provides a valuable tool to reference time zones in all parts of the world.

Chapter 1

Overview

This chapter introduces the frequency spectrum, provides an overview of spectrum management operations, and describes the core functions related to spectrum management operations within the context of Army operations. This chapter also provides an overview of spectrum management operations task.

ELECTROMAGNETIC SPECTRUM

1-1. The electromagnetic spectrum is a continuum of all electromagnetic waves arranged according to frequency and wavelength. Multiple radiated signals coexist in the same physical space and selectively detected using the appropriate equipment and channel. The spectrum extends from below the frequencies used for radio (at the long-wavelength end) through gamma radiation (at the short-wavelength end). Divided into alphabetically designated bands for specific wavelengths and frequency ranges, the spectrum encompasses wavelengths from thousands of kilometers to a fraction of an atom. Radio signals are able to coexist in the same physical space. Radio frequency spectrum is the continuum of frequencies of electromagnetic radiation from 3,000 Hertz (Hz) or 3 kilohertz (kHz) to 300 gigahertz (GHz). Isolation of multiple users of spectrum is possible by allocating different bands of this continuum to them.

Note. See Appendix C for an overview of spectrum physics.

Constrained Environment

1-2. Gaining and maintaining control of the electromagnetic spectrum is a critical requirement for the commander. From communications, to intelligence collection, to electronic warfare, all forces, and supporting agencies depend on the electromagnetic spectrum to execute operations in the air, land, maritime, space, and cyberspace domains. Within the electromagnetic spectrum, joint forces contend with civil agencies, commercial entities, allied forces, and adversaries for use of a common electromagnetic spectrum resource. This demand for electromagnetic spectrum use results in a constrained, congested, and contested environment that affects operations across all domains and functions. This contention and competition produces a constrained environment regarding how, when, and where to use electromagnetic spectrum resources.

1-3. Congestion in the electromagnetic spectrum results when multiple users attempt to use the same portions of the spectrum simultaneously. This competition and congestion can potentially lead to the operational failure of systems during critical missions due to electromagnetic interference. Adversaries can exploit modern technologies to develop sophisticated electronic attack capabilities, contesting the ability of all military assets to access and use the electromagnetic spectrum.

1-4. Army spectrum managers' tasks include planning, managing, coordinating, and providing policies and regulations for the use of the electromagnetic spectrum. The Army shares spectrum related resources with other Services, civilian counterparts, and friendly forces. Due to the large quantity of devices and forces using the spectrum, portions may be unavailable. Environmental factors such as solar activity and weather can adversely affect SMO. The Army spectrum manager uses knowledge and spectrum management tools to determine how to best support a mission with limited spectrum resources. Solutions can be as simple as having a unit switch to a different frequency or as complex as adjusting the entire spectrum plan. There are times when the commander prioritizes spectrum use to conduct operations.

Spectrum Dependent Devices

1-5. The spectrum manager is the commander's resident expert who provides course of action (COA) recommendations based on software modeling and simulation to mitigate spectrum use problems. The spectrum manager is vital to ensuring all spectrum dependent devices (SDD) operate as intended without suffering or causing harmful interference. Devices that utilize the electromagnetic spectrum to emit, receive, monitor frequencies are referred to as SDDs. SDDs include any conceptual, experimental, developmental, operational transmitter, receiver, or device that uses any portion or part of the electromagnetic spectrum.

1-6. SDD systems include, but are not limited to transmitter, receivers, command and control systems and platforms, electronic warfare assets, sensors, beacons, navigational aids, radio and radio systems, radar systems, remote controlled robotic equipment, manned and unmanned aircraft systems. Electromagnetic interference is any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics or electrical equipment. It can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses and intermodulation products.

Note. See CJCSM 3320.02F for further information on electromagnetic interference.

1-7. Spectrum users should understand that it is not a replaceable resource like fuel or ammunition. Once the allotted spectrum to support a specific capability or system is in use, it is no longer available for use depending upon system and environmental variables. The commander may need to operationally assess the impact of sacrificing other potentially critical capabilities to ensure the use of another spectrum dependent user. Spectrum management operations are the oversight of all characteristics of electromagnetic radiation. The goal is to protect systems from harmful interference while allowing the optimum use of the spectrum. The process is complex since the characteristics of electromagnetic radiation vary with time, space, and frequency.

1-8. Figure 1-1, on page 1-3, displays a portion of the spectrum used by various systems and devices both commercial and military that compete for these bands (acronyms in graphic are not essential to understanding the text).

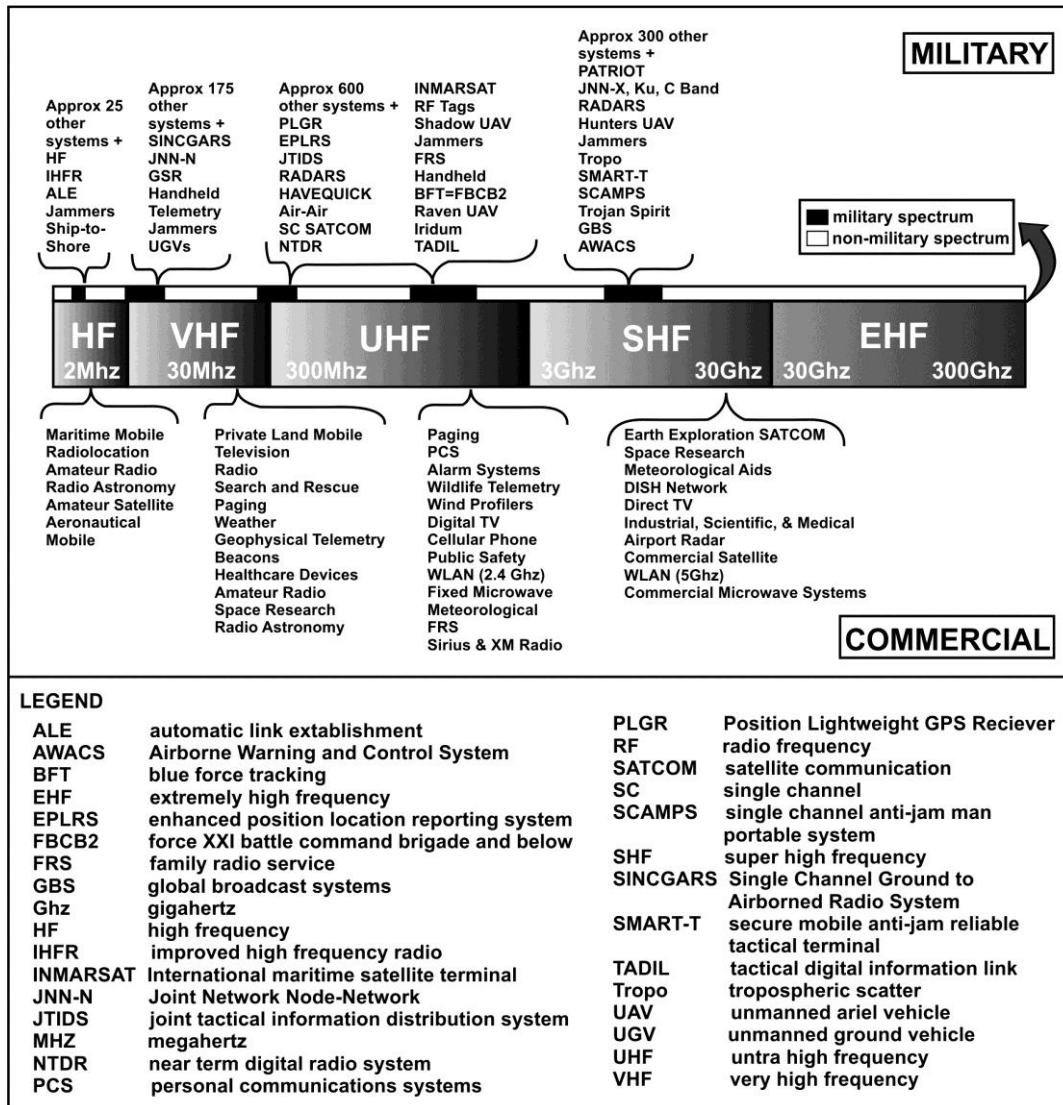


Figure 1-1. Electromagnetic spectrum competition

DEFINITION

1-9. SMO are the interrelated functions of spectrum management, frequency assignment, host nation coordination, and policy that together enable the planning, management, and execution of operations within the electromagnetic operational environment (EMOE), during all phases of military operations. The portions of the electromagnetic spectrum, experienced and influenced by military operations is the EMOE. Electromagnetic spectrum operations include electronic warfare for which the Cyber Center of Excellence is the proponent. Electromagnetic spectrum operations includes all activities in military operations to control the spectrum. SMO is the management portion of electromagnetic spectrum operations. Figure 1-2, on page 1-4, depicts the various areas of responsibility as they pertain to EMOE.

1-10. Army spectrum managers coordinate and collaborate with spectrum managers working in joint environments. Collaboration with joint personnel is common and necessary for the Army spectrum manager while using the highly saturated and limited spectrum available. The primary goal of joint electromagnetic spectrum operations is to enable SDD to perform their functions in the intended environment without causing or suffering unacceptable interference. Joint electromagnetic spectrum operations are those activities consisting of electronic warfare and joint electromagnetic spectrum management operations used to exploit,

attack, protect, and manage the electromagnetic operational environment to achieve the commander's objectives.

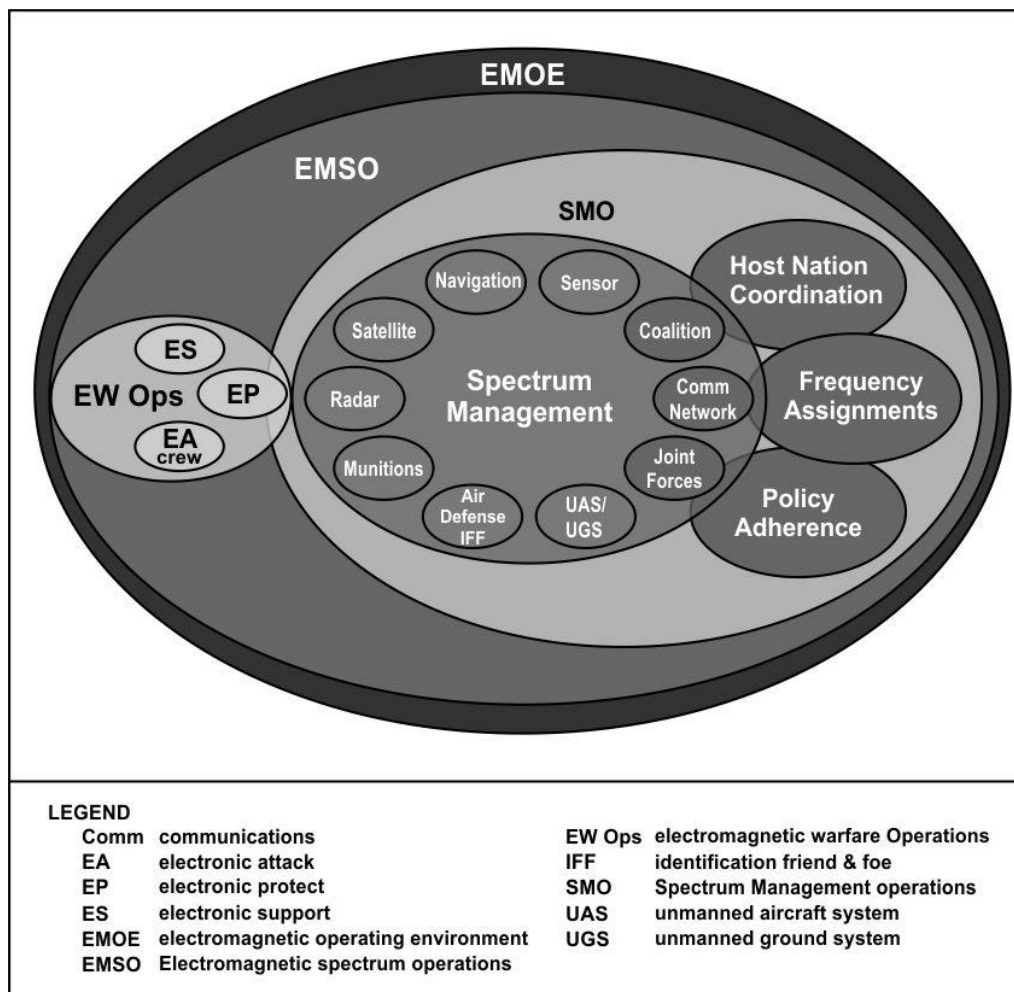


Figure 1-2. The electromagnetic operational environment (EMOE)

1-11. SMO is a supporting function or enabler for many of the Army unified land operations. SMO is a primary component of CEMA, which consists of cyberspace operations, electronic warfare, and spectrum management operations. CEMA enables the management of the electromagnetic spectrum in support of mission command. These activities employ the same technologies, capabilities, and enablers to accomplish assigned tasks resulting in the commander's integration and synchronization across all command echelons and warfighting functions as part of the operations process.

Note. Refer to ADRP 3-0 for further information.

OBJECTIVE

1-12. The objective of Army SMO is to ensure access to the electromagnetic spectrum in support of users conducting the Army's operational missions. SMO enables the allotment of the vital, but limited, natural resource that directly supports operational forces throughout the world. The Army is dependent upon the use of the radio frequency spectrum at all levels of unified land operations. An effective spectrum management operations program enables electronic systems to perform their functions in the intended environment without causing or suffering unacceptable performance.

1-13. Commanders must have the ability to see the use of their assigned spectrum resources so they can apply systematic management controls in the logistics and mission command arenas. The electromagnetic spectrum is a vital warfighting resource that requires the same planning and management as other critical resources such as fuel, water, and ammunition. Spectrum managers, with the appropriate expertise and tools, ensure that commanders have adequate knowledge of the utilization of the frequency spectrum to make decisions that positively influence accomplishment of their missions.

CORE FUNCTIONS

1-14. The SMO core functions determine the tasks and requirements of the Army spectrum manager. These four functions are—

- **Spectrum Management:** Spectrum management is the planning, coordinating, and managing of joint use of the electromagnetic spectrum through operational, engineering, and administrative procedures. Spectrum management consists of evaluating and mitigating electromagnetic environmental effects, managing frequency records and databases, de-conflicting frequencies, frequency interference mitigation, allotting frequencies, spectrum supportability assessments, and electronic warfare coordination to ensure SDD operate as intended.
- **Frequency Assignment:** The request and issuance of authorizations to use frequencies for specific equipment such as combat net radio and Army common user systems is a task of frequency assignment. This also includes the planning necessary for combat net radio, Army common user systems, and associated systems. Examples of frequency assignment are assigning the frequencies necessary to generate single-channel ground and airborne radio system (SINCGARS) hopsets, providing frequencies for unmanned aerial systems and line of sight networks, or assigning frequencies for the Warfighter Information Network-Tactical (WIN-T) network.
- **Host Nation (HN) Coordination:** Each nation has sovereignty over its electromagnetic spectrum within its geographic area and negotiates the use of the spectrum on a case-by-case basis. A representative of the sovereign country evaluates each Department of Defense (DOD) request for the use of spectrum based on the perceived potential for electromagnetic interference (EMI) to local receivers. Use of military or commercial spectrum systems in host nations requires coordination and negotiation that result in formal approvals and certifications.
- **Policy Adherence:** The commanders ability to access and maneuver within the electromagnetic spectrum is dependent on policy. Policy are those authoritative instruments from the national strategic through the tactical level that nest and shape the spectrum management, frequency assignment, and host nation coordination process. Countries coordinate global international spectrum use through the International Telecommunications Union and the World Radio Communication Conference. At the U.S. national level under U.S. Code Title 47, the division of spectrum management responsibility rests with the National Telecommunications and Information Administration (NTIA) for federal frequencies and the Federal Communications Commission for non-federal frequencies. The Military Communications-Electronics Board (MCEB) is the main coordinating body for spectrum matters among DOD components. Overseas, the U.S. mission, working with DOD strategic partners, negotiates treaties and agreements when stationed or training U.S. forces are within a host nation. These agreements establish lines of communications between the host-nation and senior military commands to negotiate spectrum usage in support of training and operations. Examples of policy instruments include International Telecommunications Union and World Radio Communication Conference agreements, status of forces agreements, host-nation agreements, operational orders, U.S. Code Title 47, and operations plans.

ARMY SPECTRUM MANAGEMENT OPERATIONS PROCESS

1-15. The Army SMO process comprises three interacting and continuous activities: planning, coordinating, and operating (see figure 1-3, on page 1-6). The Army SMO process is a means of planning that continues through all phases of the mission. During the execution of unified land operations, these functions occur concurrently.

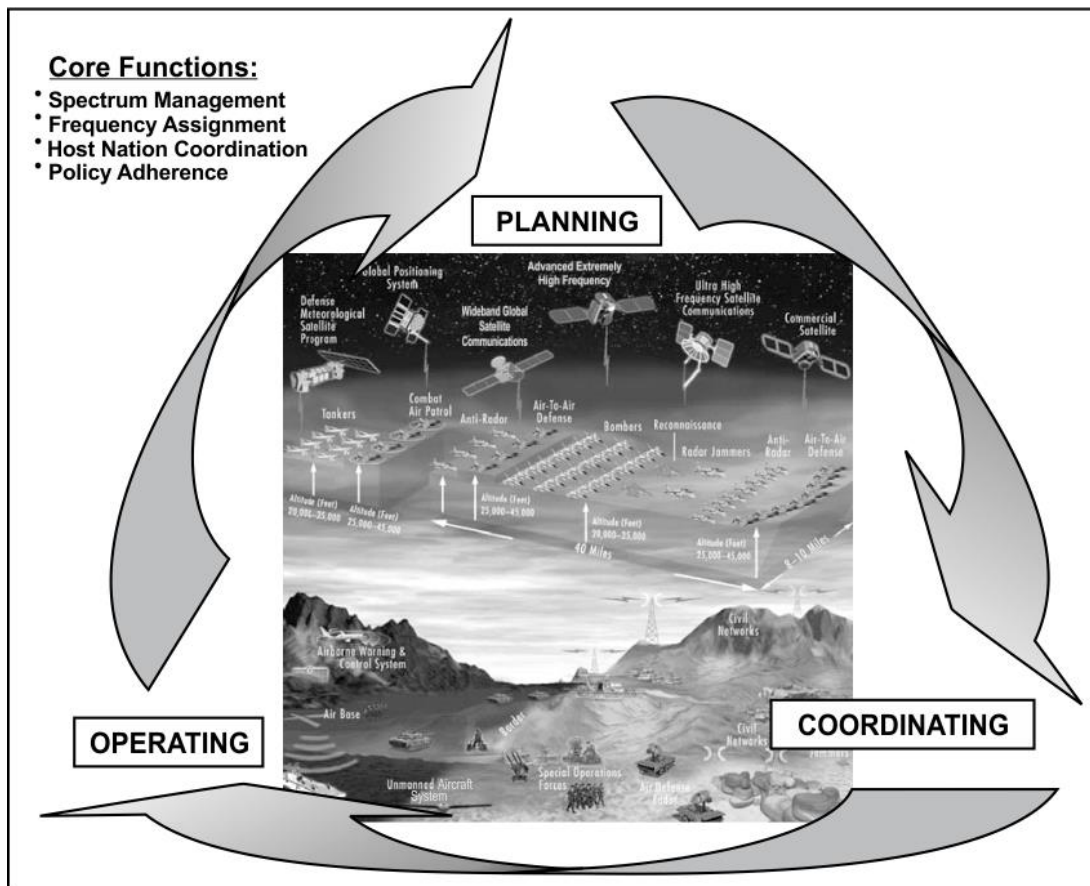


Figure 1-3. Army spectrum management operations process

PLANNING

1-16. SMO planning includes the identification of spectrum requirements for training, pre-deployment, deployment, and reconstitution of Army forces, both in and outside the continental U.S. SMO planning is an on-going process that must be deliberate as well as dynamic to support unified land operations. It requires the collection, storage, and protection of critical spectrum data, and assured access to this data by spectrum planners on a global scale. Additionally, planning for the establishment of lines of communications for coordination of spectrum use with national and international government and non-government agencies is critical to the spectrum planning process.

1-17. The CEMA element and the CEMA working group have an assigned spectrum manager that provides expertise in planning and coordinating horizontally and vertically to support unified land operations. The spectrum manager's primary role is to assist with de-conflicting detection and delivery assets through the planning and targeting processes.

COORDINATING

1-18. Coordination ensures initial spectrum availability and supportability for operations. Lines of communication for coordinating spectrum allocation at the national and international level are primarily a matter of policy established in the planning process. Enemy nations or their military do not receive U.S. host nation coordination. Spectrum managers coordinate adjacent countries spectrum, particularly if forces stage, train, or operate within these countries, to include airspace, sovereign waters, and frequencies for satellites. Coordination at the operational Army level requires prior coordination as well as a dynamic, instantaneous collaboration tool.

1-19. **Staff Coordination**-Spectrum managers coordinate with various staff sections to ensure effective SMO. Commanders engage spectrum managers early in the planning process when forecasting for the use of spectrum dependent devices. Staff coordination, electronic warfare (EW) coordination, communications security coordination, satellite coordination, frequency deconfliction, frequency interference resolution, and joint restricted frequency lists are SMO tasks that support spectrum functions.

1-20. Spectrum managers work with many systems that are not exclusively communications systems. They must interact with other staff members to provide guidance, assistance, and advice to the commander regarding the use and prioritization of the spectrum. Systems such as unmanned aerial systems, common user jammers, radars, navigational aids, and sensors all use the spectrum for operation. Their extensive use and unique operating characteristics necessitate special planning and coordination to mitigate frequency fratricide.

1-21. **Unified Action Partners**-Coordinating spectrum use is the process of collaborating with unified action partners. Unified action partners are those military forces, governmental and nongovernmental organizations, and elements of the private sector with which Army forces plan, coordinate, synchronize, and integrate during the conduct of operations. This function ensures initial spectrum availability and supportability for operations. Lines of communication for coordinating spectrum allocation at the national and international levels are primarily a matter of policy established in the planning process.

1-22. **Host Nation Coordination**-Use of military or commercial spectrum systems in host nations requires coordination and negotiation that result in formal approvals and certifications. Coordination for use of the spectrum in host nations is required if forces stage, train, or operate within these countries to include airspace, sovereign waters, and frequencies for satellites. Prior coordination as well as dynamic, immediate collaboration tools results in a seamless use of the spectrum. Failure to request frequency usage in a timely manner results in the inability to operate communications equipment in the host nation. Each nation has sovereignty over its spectrum within its geographic area and negotiates the use of spectrum on a case-by-case basis. A representative of the sovereign country evaluates each DOD request for the use of spectrum based on the perceived potential for EMI to local receivers.

1-23. The host nation spectrum worldwide database online (HNSWDO) is a tool, used by military service department spectrum management offices, to track DOD host nation spectrum supportability request to determine equipment supportability. Host nation access request are added to HNSWDO by the sponsoring service spectrum management agency. Requests are sent to the respective combatant command's joint frequency management office (JFMO) to annotate comments in HNSWDO for visibility. Tactical spectrum managers coordinate frequency assignments through established spectrum coordination channels. Spectrum management offices assuming the role of the Joint Spectrum Management Element (JSME) may be delegated by the combatant command JFMO to perform person-to-person host nation coordination in support of joint task force operations.

1-24. **Electronic Warfare Coordination**-The spectrum manager should be an integral part of all EW planning to provide awareness of spectrum conflicts initiated by friendly systems for personnel protection, enemy exploitation, or enemy denial. The advent of common user "jammers" has made this awareness and planning critical for the spectrum manager. In addition to jammers, commanders and staffs must consider non-lethal weapons that use electromagnetic radiation. EW coordination normally takes place in the CEMA working group. It may take place in the EW Cell if it is operating under a joint construct or operating at a special echelon.

1-25. **Communications Security Coordination**-Spectrum managers work closely with communications security personnel to ensure the proper keying material for the appropriate frequency resource of SINCGARS loadsets. Spectrum managers only manage and process communications security for SINCGARS by way of loadsets. They do not manage communications security for other emitters.

1-26. **Satellite Coordination**-Spectrum managers coordinate with satellite managers to maintain awareness of channels (frequencies) used by satellite communications systems. The satellite manager generates and processes satellite access requests. Spectrum managers receive and verify the information provided in the satellite access request for all satellite communications. Once approved, the spectrum manager enters the frequencies into the spectrum database for frequency deconfliction with all other emitters in the area of operations.

1-27. **Frequency Deconfliction**-Frequency deconfliction is a systematic management procedure to coordinate the use of the electromagnetic spectrum for operations, communications, and intelligence functions. Frequency deconfliction is one element of electromagnetic spectrum management and applies practices to minimize or prevent spectrum dependent devices from suffering or causing interference while being used as intended. It is easy to confuse EMI mitigation with frequency de-confliction. The main difference is that frequency deconfliction occurs during the planning phase of a mission while EMI mitigation occurs during mission execution.

1-28. **Joint Restricted Frequency List (JRFL)**-The JRFL is a concise list of highly critical protected frequencies and nets categorized as Taboo, Protected, and Guarded. Commanders and planners prohibit jamming or attacking frequencies listed on the JRFL. The JRFL includes command channels of senior commanders and safety-of-life frequencies used by local civilian noncombatants. Usually listed in the JRFL are international distress, safety, and controller frequencies.

1-29. High priority nets, bands, and frequencies are protected from friendly electronic attack (EA) when possible however, the concern of the spectrum manager is to ensure that all friendly systems have the ability to operate unimpaired. This can be accomplished by simply adding the offending jammer to a database and using spectrum management techniques (such as changing frequencies, assignments, or moving to an unaffected area) to accomplish the mission. The spectrum manager has tools that can identify potential frequency fratricide if properly utilized, ultimately saving lives. Refer to paragraph 5-36 and appendix A for further information on the JRFL.

Note. Use of the JRFL will not deconflict all frequency issues. The JRFL does not provide communications planners with frequencies EA systems transmit or the technical information needed to deconflict EA from friendly operations including lower echelon maneuver forces. Efficient utilization of spectrum management tools identifies potential interference and frequency conflicts during mission planning reducing frequency fratricide.

1-30. **Interference Resolution**-The spectrum manager performs interference resolution at the echelon receiving the interference. Interference is the radiation, emission, or indication of electromagnetic energy; either intentionally or unintentionally causing degradation, disruption, or complete obstruction of the designated function of the electronic equipment affected. The spectrum manager should utilize available near-real time monitoring and analysis capabilities to aid in the interference resolution. The reporting end user is responsible for assisting the spectrum manager in tracking, evaluating, and resolving interference. Appendix D contains further information on frequency interference resolution and reporting.

OPERATING

1-31. The operating activity for SMO enables and sustains the functions of planning and coordinating. It includes the process to plan, conduct, coordinate, and sustain spectrum operations. SMO ensures the efficient use of allocated spectrum and associated frequencies in a given area of operations. Spectrum managers use the operating function to enable dynamic, near instantaneous frequency assignment, re-assignment, interference mitigation, and frequency deconfliction across all users in an area of operations. The architecture provides for interoperability with U.S. national, local government and non-government agencies as well as unified action partners.

Chapter 2

Tactical Staff Organization and Planning

SMO is dynamic and requires continuous coordination among all echelons and warfighting functions both laterally and horizontally to mitigate harmful interference. This chapter describes SMO functions for staff organizations at the corps and below level, and provides an overview of division, brigade and battalion spectrum operations. This chapter also describes how SMO is incorporated within the military decisionmaking process and shows how the spectrum manager supports the common operational picture.

SPECTRUM MANAGEMENT OPERATIONS FOR CORPS AND BELOW

2-1. The goal of tactical SMO is to protect and provide access to the spectrum so that it serves the needs of friendly forces. Spectrum operations at the tactical level can be a very complicated and time-consuming process.

2-2. In the past, the bulk of spectrum management was concerned with networked communications emitters and combat net radio networks. Today, the tactical environment includes a vast number of SDD operating in all regions of the spectrum across the battlefield. The key to sound spectrum management is having an understanding of all emitters and receivers in the operational area while being able to deconflict these systems. As stated earlier, the commander must be aware that the spectrum is a limited resource and that efficient spectrum use is critical to enabling the warfighting functions.

Note. SMO is bottom driven for requirements while top fed for resources. The brigade combat teams represent the pointy end of the spear and it is critical that the staff at each echelon captures all requirements to ensure commanders receive the proper resources. Maximizing the use of the spectrum requires coordination between EW, network operations, intelligence staffs, and other known users.

2-3. Figure 2-1, on page 2-2, illustrates the competing systems that cause challenges throughout the spectrum. The assistant chief of staff for communications, signal staff officer (G-6) or the battalion or brigade signal staff officer (S-6) is responsible for coordination with all spectrum users within a given operational area, to identify all requirements for spectrum access, and to conduct frequency deconfliction. They also maintain a database of all known emitters and receivers in the operational area to identify and prioritize competing systems for frequency assignments.

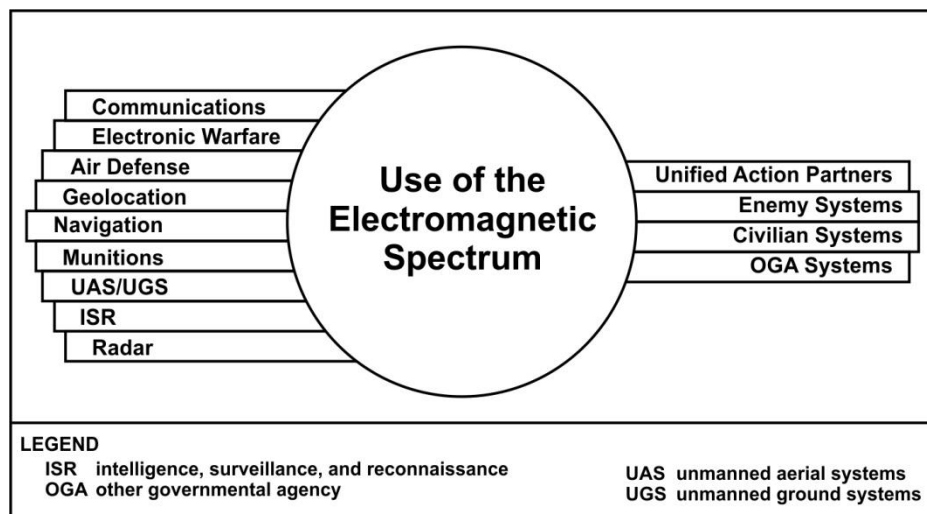


Figure 2-1. Use of the electromagnetic spectrum

CORPS SPECTRUM OPERATIONS

2-4. There are three spectrum managers within the G-6 staff and one located in the assistant chief of staff, operations section (G-3). The spectrum management chief is the principle advisor to the commander for spectrum management related matters and is the Army spectrum authority in a corps operational area. Two other spectrum managers assist the spectrum management chief in performing corps spectrum management duties. Normally, one assists the network planners and the other manages the signal operating instructions (SOI) and other functions that fall outside of the network. The spectrum manager assigned to the G-3 conducts electronic warfare deconfliction, coordination and planning and advises the Electronic Warfare Officer (EWO) on potential spectrum conflicts and issues. The corps spectrum management chief may be designated as the joint task force spectrum manager if the Army is the lead service in a joint operation.

2-5. At the corps, spectrum operations place more emphasis on host nation coordination, establishing policy and procedure to assure the necessary spectrum is available for operations, and ensuring subordinate units efficiently use spectrum resources. The spectrum manager accomplishes this through the development of standard operating procedures based on joint and service regulations, instructions, policies, and doctrine.

2-6. The corps spectrum manager's responsibilities include the following—

- Assist in the development and publishing of communications annexes and appendices.
- Develop, produce, and disseminate spectrum operations standard operating procedures.
- Create and send a data call message (see appendix A for a description of data call message).
- Determine if the unit's devices have spectrum supportability.
- Coordinate host nation spectrum use.
- Develop, create, and distribute the SOI.
- Coordinate and participate with other staff sections and cells.
- Coordinate with unified action partners.
- Perform prescribed reviews for frequency use and requirements.
- Provide frequency-engineering support for communications network design and operations.
- Conduct EMI identification, analysis, mitigation, and reporting.
- JRFL production and promulgation.
- Advise the EWO on potential spectrum conflicts and issues.
- On order, assume the roles and responsibilities of the joint task force joint spectrum management element (JSME).

Note. See CJCSM 3320.01 for JSME responsibilities.

DIVISION, BRIGADE AND BATTALION SPECTRUM OPERATIONS

2-7. The roles of division and brigade spectrum managers are similar at their respective levels. The brigade spectrum manager gathers, validates, and forwards requirements for all spectrum support to the division. In turn, the division forwards its requirements to the next higher authority.

2-8. There are two spectrum managers at the G-6 and one in the G-3 per division. Normally, one spectrum manager is responsible for the network frequency assignments to include satellite access authorization deconfliction. The network planners design the network that determines the spectrum requirement and the spectrum manager uses this design to request the spectrum requirements necessary for the communications network. Another spectrum manager is responsible for combat net radio, radar, and other systems requirements. The G-3 spectrum manager provides support for fires, EW deconfliction, and coordination and planning.

2-9. Brigade spectrum managers are located in the S-6 and S-3 to maintain visibility of all spectrum related matters in the brigade. The brigade and in some instances the battalion (selected maneuver units) is currently the lowest echelon to have a spectrum manager. Echelons lower than brigades or battalions coordinate their spectrum requirements and concerns through the brigade spectrum manager.

2-10. The division, brigade or battalion spectrum manager's responsibilities include the following—

- Advise the commander in spectrum prioritization and implementation.
- Build and distribute SINCGARS loadsets.
- Request, obtain, and distribute frequencies for all devices.
- Perform spectrum network analysis to engineer line of sight radio links and assign frequencies.
- Advise network planners in matters concerning spectrum management.
- Maintain and update spectrum related databases.
- Advise and coordinate with EW personnel for frequency planning and use.
- Perform spectrum analysis and frequency deconfliction.
- Coordinate satellite frequency deconfliction.
- Conduct electromagnetic interference identification, analysis, mitigation, and reporting.
- Coordinate with Army Aviation Units to determine and mitigate interference.
- Perform situational awareness and analysis using a spectrum analyzer or monitoring receiver.
- Perform propagation analysis for high frequency and tropospheric scatter systems.
- Assist in JRFL production and promulgation.
- Assist in spectrum supportability determinations.
- Develop and maintain the EMOE picture by capturing and recording all unit SDDs with appropriate tools and databases.
- On order, the Division SMO assumes the roles and responsibilities of the joint task force J-6 JSME as required.

Note. See CJCSM 3320.01 for JSME responsibilities.

SPECTRUM MANAGERS ASSIGNED TO CYBER ELECTROMAGNETIC ACTIVITY WORKING GROUP

2-11. When established, the CEMA working group is accountable for integrating CEMA and related actions into the concept of operations. CEMA working groups do not add additional structure to an existing organization. The CEMA working group is a collaborative staff meeting led by the EWO to analyze, coordinate, and provide recommendations for a particular purpose, event, or function.

2-12. A spectrum manager's inherent duties include many affiliations and activities based on their assignment. Spectrum managers participate in CEMA working groups or CEMA elements as required by the command. As a member of these groups, they provide the specialized technical knowledge to enable the working group or element to provide the commander with expert knowledge on spectrum related activities.

2-13. The CEMA working group is responsible for coordinating horizontally and vertically to support unified land operations and primarily deconflict detection and delivery assets through the planning and targeting processes. (FM 3-38) Staff representation within the CEMA working group may include the G-2 (S-2), information operations officer, battalion or brigade civil affairs operations staff officer assistant chief of staff, civil affairs operations, fire support officer, space support element, judge advocate general representative (or appropriate legal advisor), and a joint terminal attack controller when assigned. Based on requirements capabilities, the CEMA working group staff may delete or modify members. The CEMA working group augments the function of the permanently established CEMA element. When scheduled, the CEMA working group is a critical planning event integrated into the staff's battle rhythm.

2-14. The CEMA working group requires a spectrum manager positioned within the working group to deconflict spectrum, identify conflicts, and mitigate possible frequency fratricide during the planning phase of all forms of fire. Frequency fratricide is the unintentional interruption of friendly frequencies. Frequency fratricide can cause many problems for operations and prevention is the key. Spectrum managers provide the working group with frequency options and advice that follows internal and external policies that minimize frequency fratricide.

2-15. To accomplish the task of integration of CEMA into all unit operations, the EWO leads the CEMA working group, which determines EW requirements and integrates these requirements into the unit's planning and targeting processes. One role of the EW team in CEMA is to coordinate the operational targeting of effects in cyberspace.

CYBER ELECTROMAGNETIC ACTIVITIES ELEMENT

2-16. The CEMA element consists of personnel that plan, prepare, and synchronize cyberspace operations, EW, and SMO. The element, led by the electronic warfare officer (EWO), provides staffs expertise for the planning, integration, and synchronization of cyberspace operations, EW, and SMO. When the mission dictates, the CEMA element can leverage other additional skill sets of the CEMA working group. When operating in a joint, multinational, or intergovernmental environment, commanders may reorganize their staffs to better align with higher headquarters. The CEMA element is an organic organization in brigade, division, corps, and theater Army staffs (FM 3-38).

2-17. The key personnel involved in planning and coordination in the CEMA element are the—

- EW staff.
- Spectrum manager.
- Assistant chief of staff, intelligence (G-2) or battalion or brigade intelligence staff officer (S-2).
- Assistant chief of staff, signal (G-6 [S-6]) staff.

ELECTRONIC WARFARE STAFF

2-18. The EWO functions as the commander's designated staff officer for the planning, integration, synchronization, and assessment of CEMA and uses other members of the staff to integrate CEMA into the commander's concept of operations. The EWO is responsible for understanding all applicable classified and unclassified policy relating to cyberspace, EW, and electromagnetic spectrum to properly inform the commander on the proper planning, coordination, and synchronization of CO, EW and SMO. The EWO is the commander's subject matter expert on CREW.

SPECTRUM MANAGER

2-19. As a key member of the CEMA element, the spectrum manager coordinates spectrum use for a wide variety of communications and electronic resources. Some of the primary functions the spectrum manager provides include—

- Coordinates the preparation of the JRFL and issuance of emissions control guidance.
- Coordinates frequency allotment, assignment, and use.
- Coordinates electromagnetic deception plans and operations in which assigned communications resources participate.
- Coordinates measures to eliminate, moderate, or mitigate electromagnetic interference.
- Coordinates with higher echelon spectrum managers for electromagnetic interference resolution they cannot resolve internally.
- Assists the EWO in issuing guidance to the unit (including subordinate elements) regarding deconfliction and resolution of interference problems between EW systems and other friendly systems.
- Participates in the CEMA working group to deconflict friendly spectrum requirements with planned EW, CO, and intelligence collection.
- Synchronizes frequency allotment and assignment use with the G-6 or J-6 spectrum manager.

2-20. The working groups may include, but are not limited to, key members of operations, intelligence, communications, training, air liaison officer, fires, special technical operations, and liaisons from supported units. Figure 2-2. CEMA depicts the working group organizational framework.

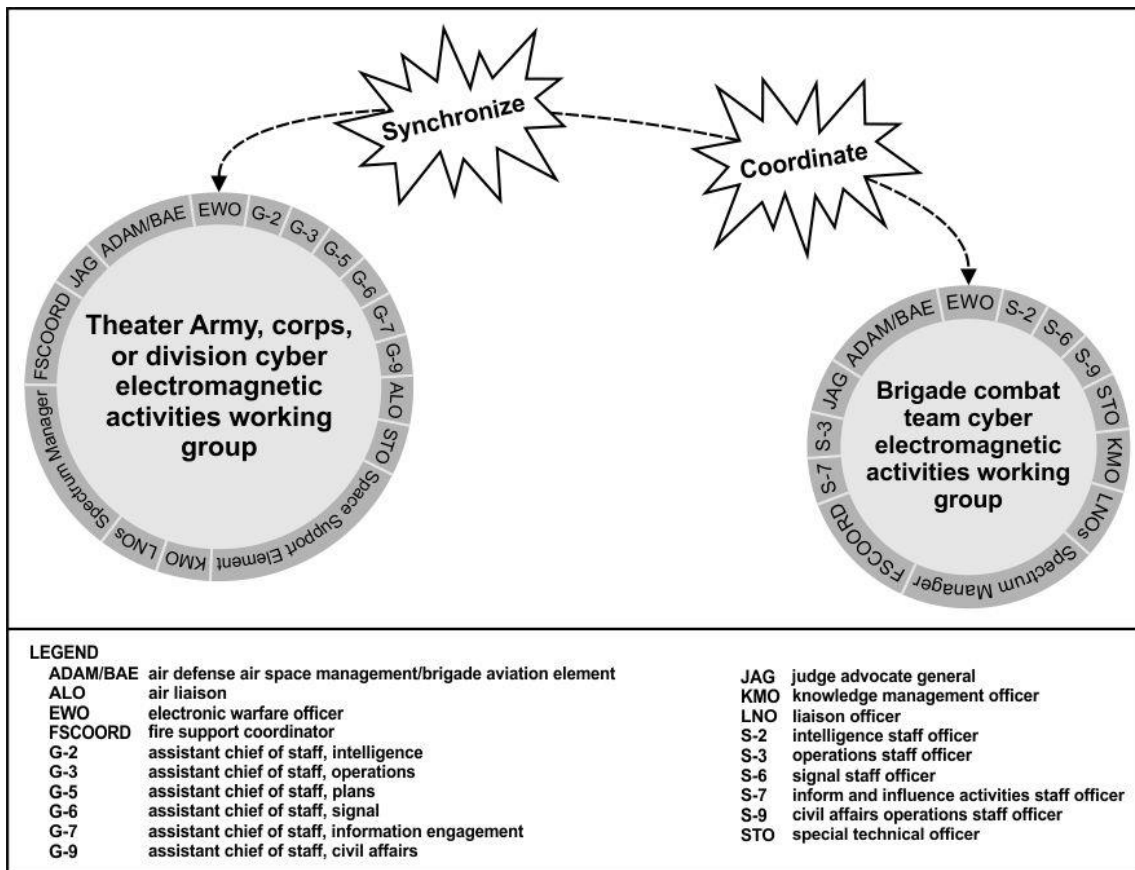


Figure 2-2. CEMA working group organizational framework

TIPS FOR SPECTRUM MANAGERS

2-21. The following tips provide guidance to spectrum managers for further understanding of the types and number of emitter devices in their unit. This information leads to a firm understanding of the spectrum requirements and mitigates the need to request resources multiple times.

- Obtain a detailed in-briefing from the outgoing spectrum manager.
- Meet and establish a rapport with other staff entities, such as electronic warfare, intelligence, communications, operations, cyber, and logistics. This builds avenues for coordination during mission planning and execution.
- Identify all devices by analyzing the modified table of organization and equipment and other documents that contain equipment lists.
- Understand the requirements of the unit's devices by understanding their mission.
- Provide recommendations to the commander regarding unauthorized frequency use by devices causing interference to certified SDD and suspending or modifying spectrum use.
- Visit all entities within the unit and ask what types of emitter devices they have. This can often identify devices that are not in current databases.
- All emission devices must have a completed DD Form 1494 to operate in the operational area of the unit. Completion of the DD Form 1494 is the responsibility of the material developer. The material developer must provide a collection of technical data about the device to begin the planning process by placing the technical data in SMO tool databases. Report the characteristics to higher echelon spectrum management agencies to receive authorization for using the device in the operational area.
- Meet with unit commanders to discuss spectrum management options. This provides the commander with valuable information to incorporate in the military decisionmaking process (MDMP) and provides a point of contact for spectrum concerns.
- Maintain a library, either paper or electronic, of spectrum related manuals, to include national, international, and governmental regulations and policies. An excellent start to this library includes the manuals listed in the reference section of this text.
- Become familiar with the operational area for the unit. In particular, know the agencies, national and international, that regulate spectrum use and obtain their contact information.
- Become familiar with unit SMO tools and develop databases for them. Build force templates that include spectrum devices and spectrum requirements to aid in mission planning. Obtain map files, such as digital terrain elevation data for the operational area of the unit.
- Begin an informal handbook relating to spectrum management functions specific to the unit. The goal of the handbook is to serve as a reminder for completing the same tasks in the future. The handbook provides for an excellent start to the in briefing to future incoming spectrum managers.
- Collaborate with unit the G-6 signal officer and unit commanders to discuss policy impacts on use of locally procured equipment and the ability to operate in support of training and operational environment.
- Understand command and policy relationships between combatant commands and the joint force providers.
- Development or acquisition of systems that meet operational requirements, but fail to obtain formal spectrum supportability are not allowed operation in the U.S. or in host nations. These systems create the potential for severe mutual interference between the system and other spectrum users, to squander resources and delay fielding war fighting capabilities to units. An approval number, documented on the emitters DD Form 1494, indicates approval to coordinate for spectrum resources. The joint spectrum center database web server contains approved DD Form 1494s. Completion and submission of an emitter's DD Form 1494 is conducted thru the sponsoring military department, further coordination is the responsibility of the material developer.

Note. For more information on the Army spectrum supportability process, see AR 5-12.

- Home station operations provide unique challenges and opportunities for tactical spectrum managers. The challenges come in the form of equipment returning from overseas theaters that does not have spectrum supportability within U.S. territories.
 - Another challenge is that the spectrum manager on a post, camp, or station now normally deals with a civilian counterpart for spectrum support who may not be as familiar with tactical requirements. Within these challenges lie opportunities for training with other units, agencies, and directorates on the installation. Informal luncheons or meetings are a good way to share information and lessons learned from previous experiences.
-

Note. According to the MCEB Publication 8, complete the spectrum supportability process for all devices (emitters and receivers) as early as possible to prevent the use or acquisition of a device that is unsupportable, cause interference, or not authorized for use within the operational area of a mission.

THE MILITARY DECISIONMAKING PROCESS

2-22. The MDMP is an iterative planning methodology to understand the situation and mission, develop a course of action, and produce an operation plan or order. The MDMP is the Army's analytical approach to problem solving. The MDMP is a tool that assists the commander and staff in developing estimates and a plan.

2-23. SMO has inputs to each step in the MDMP. The MDMP produces the greatest integration, coordination, and synchronization for an operation and minimizes the risk of overlooking a critical aspect of the operation. The complete MDMP results in a detailed operation order or operation plan. The disadvantage of using the complete MDMP is that it is a time-consuming process. For further information concerning the MDMP please review FM 6-0, chapter 9.

2-24. Key inputs for the MDMP are actions, processes or information spectrum managers provide to the MDMP. SMO key outputs for MDMP are the completed SOI, reports, frequency proposals or data call messages. Figure 2-3, on page 2-8, depicts the key SMO inputs and outputs for each step of the MDMP.

Key SMO Inputs	Steps	Key SMO Outputs																																
<ul style="list-style-type: none">• Updated EMS databases• Unit force structure• Library of EMS documents• HN allocation tables• Gather SMO tools	Step 1: Receipt of Mission	<ul style="list-style-type: none">• Defined EMOE• Data call message• Identify EMS constraints• JFRL guidance																																
<ul style="list-style-type: none">• Identified EMS capabilities pertaining to combat power• List of unit's spectrum dependent device• Frequency requests• JRFL requests	Step 2: Mission Analysis	<ul style="list-style-type: none">• Prioritized EMS use• Completed JRFL• Frequency reuse plans• Initial EMS risk assessment																																
<ul style="list-style-type: none">• Commander's intent• Frequency allotments• Initial frequency assignments• SSA/DD-1494 for unit's spectrum dependent device	Step 3: Course of Action (COA) Development	<ul style="list-style-type: none">• M&S of EMS to develop multiple COAs• EMI/EW deconfliction• Initial Spectrum Plan• EMS COP																																
<ul style="list-style-type: none">• Initial Spectrum Plan• Mitigating factors to decrease EMS risk	Step 4: COA Analysis (War Game)	<ul style="list-style-type: none">• M&S shows EMS advantages / disadvantages for each COA• Continues analysis of EMS risk assessment																																
<ul style="list-style-type: none">• Optional unit movement routes for planning COTM• Refines EMS COAs	Step 5: COA Comparison	<ul style="list-style-type: none">• M&S depicts EMS use to compare COAs• Recommended EMS COAs																																
<ul style="list-style-type: none">• Recommended EMS COA• Coordinated frequency conflicts	Step 6: COA Approval	<ul style="list-style-type: none">• Commander selected EMS COA and any modifications• Frequency proposals																																
<ul style="list-style-type: none">• Frequency assignments/ allotments from higher echelon ESM• HN frequency clearance• CREW loadsets	Step 7: Orders Production, Dissemination and Transition	<ul style="list-style-type: none">• The Spectrum Plan• SOI/JCEOI• Annex H of OPORD• Distribute frequency assignments to requestors• CNR loadsets																																
LEGEND <table><tr><td>CNR</td><td>combat net radio</td><td>HN</td><td>host nation</td></tr><tr><td>COP</td><td>common operational picture</td><td>JCEOI</td><td>joint communications-electronics operating instructions</td></tr><tr><td>COTM</td><td>communications on the move</td><td>JRFL</td><td>joint restricted frequency list</td></tr><tr><td>CREW</td><td>counter radio-controlled improvised explosive device electronic warfare</td><td>M&S</td><td>modeling and simulation</td></tr><tr><td>EMI</td><td>electromagnetic interference</td><td>OPORD</td><td>operational order</td></tr><tr><td>EMOE</td><td>electromagnetic operating environment</td><td>SMO</td><td>Spectrum Management operations</td></tr><tr><td>EMS</td><td>electromagnetic spectrum</td><td>SOI</td><td>signal operating instructions</td></tr><tr><td>EW</td><td>electronic warfare</td><td></td><td></td></tr></table>			CNR	combat net radio	HN	host nation	COP	common operational picture	JCEOI	joint communications-electronics operating instructions	COTM	communications on the move	JRFL	joint restricted frequency list	CREW	counter radio-controlled improvised explosive device electronic warfare	M&S	modeling and simulation	EMI	electromagnetic interference	OPORD	operational order	EMOE	electromagnetic operating environment	SMO	Spectrum Management operations	EMS	electromagnetic spectrum	SOI	signal operating instructions	EW	electronic warfare		
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Figure 2-3. Key SMO inputs to the MDMP

SUPPORT TO THE MDMP STEPS

2-25. SMO supports the MDMP through each step of the process. The SMO planning process incorporates each step of the MDMP in to support the commander. The following are some examples for each step—

- **Step 1: Receipt of Mission—**
 - Conducting a data call provides a list of SDD and the requirements that those devices need to perform the mission.
 - Compiling force structure templates allows the commander to determine the amount and type of SDD available for the mission.
 - Modeling the operational area, using SMO tools, with digital topography and electromagnetic environmental effects information to analyze spectrum supportability.

- Determine from governmental and host nation spectrum allocation tables, which frequencies maybe assigned in a given operational area.
- Compiling restrictions or constraints on spectrum use that prevent planning and use of protected, taboo, and restricted frequencies in the operational area. (see CJCSM 3320-01C, appendix I, enclosure C for a listing of the worldwide taboo frequencies.
- Defining the EMOE provides a common source for spectrum use information, particularly all available blue (friendly), red (enemy), and grey (neutral and civil) spectrum occupancy.
- **Step 2: Mission Analysis—**
 - Analyze the EMOE, highlighting unified action partners' spectrum users, and aid the commander in determining spectrum priority.
 - Conducting an initial spectrum risk assessment identifies the spectral impact of a mission on unified action partners in the operational area. This process also identifies frequency usage conflicts such as EMI and frequency fratricide.
 - Generating frequency reuse plans provides for spectrum optimization and increased spectrum capabilities.
 - Identifying spectrum constraints where certain frequencies are taboo, such as those not allocated for use by the host nation.
 - Determining spectrum capabilities pertaining to combat power, such as EW and counter radio controlled improvised explosive device electronic warfare systems.
- **Step 3: Course of Action Development—**
 - Modeling the unit's boundaries and movement formations, using SMO tools, to develop COA recommendations.
 - Performing EMI and EW frequency deconfliction, using SMO tools, for COA development and spectrum supportability.
 - Generating frequency allotment and allocation tables for subordinate units.
 - Identifying the unit's spectral impact on civilian spectrum users.
 - Identifying primary, alternate, contingency, and emergency communications for each COA based on unit capabilities, software simulation, and spectrum supportability.
- **Step 4: Course of Action Analysis (War Game) —**
 - Depicting the spectrum advantages and disadvantages for each COA.
 - Identifying mitigating factors for the spectrum risk assessment to reduce or eliminate risks.
 - Recommending modifications to the COA based on spectrum supportability during the war game.
- **Step 5: Course of Action Comparison—**
 - Comparing spectrum use over multiple COAs, using SMO tools, to allow the commander to determine which COA provides the best flexibility during execution while minimizing risks.
 - Analyzing routes over a movement of forces determines which route provides the best options for the commander.
- **Step 6: Course of Action Approval—**
 - Allows the unit to submit frequency proposals and receive frequency assignments.
 - Modifying COAs in accordance with commander's decision.
 - Coordinating frequency conflicts through higher echelons for mitigation assistance.
- **Step 7: Orders Production Dissemination, and Transition—**
 - Producing the SOI and joint communications-electronics operating instructions (JCEOI) and disseminate as needed to units.
 - Providing input to Annex H (Signal) of the Operations order (OPORD) that addresses all signal concerns, to include spectrum use information.

Note. Refer to FM 6-0 for additional information on Annex H of the OPORD.

THE COMMON OPERATIONAL PICTURE

2-26. The common operational picture is a single display of relevant information within a commander's area of interest tailored to user requirements and based on common data and information shared by more than one command. The SMO core functions and common tasks support completion of the COP for the commander. SMO tools, when used in conjunction with Intelligence and EW Cell information, allow the spectrum manager to collect spectrum related information tailored to the commander's operational area. These tools provide a visually depiction of force structure and geographical locations in a three-dimensional picture that personnel can understand quickly and easily. The following are some examples of SMO support to the COP—

- **Live spectrum analysis of a given area of operations:** Using SMO planning tools to receive analysis of the signal, allows the spectrum manager to perform EMI mitigation. A spectrum analyzer or monitoring receiver, a direction-finding antenna, and analysis software show persistent unplanned signals that interfere with assigned frequencies. These tools provide a three-dimensional picture to the commander with a graphical depiction of the spectral footprint of the signal, along with recommendations for frequency reassignment to maintain communications in the area and the impacted units. The commander, based on mission priority, deems it necessary to obtain new frequencies in order to accomplish the mission
- **Force Movement to a New Location:** The commander orders movement to a new location. The spectrum manager creates the proposed movement route with the SMO planning tool along with adjacent units' communications systems, sensors, and receivers. The SMO planning tool performs a simulation and provides courses of action to determine if the mission command system remains operational during the movement. The tool calculates that a direct path will cause counter radio-controlled improvised explosive device EW (CREW) interference on friendly communications along the route. The tool then presents a report with actionable information such as sources, victims, levels, and duration of interference. This provides the commander with supplementary information to make knowledgeable decisions.

Chapter 3

Support to the Warfighting Functions

SMO enables and supports the Army's warfighting functions described in ADP 3-0, *Unified Land Operations*: mission command, intelligence, fires, movement and maneuver, protection, and sustainment. A *warfighting function* is a group of tasks and systems (people, organizations, information, and processes) united by a common purpose that commanders use to accomplish missions and training objectives. This chapter links Army SMO to the warfighting functions; it also describes how SMO supports and enables commander's efforts as they exercise mission command.

MOVEMENT AND MANEUVER

3-1. The movement and maneuver warfighting function are the related tasks and systems that move forces to achieve a position of advantage in relation to the enemy. SMO enables movement and maneuver by maintaining freedom of action within the electromagnetic spectrum. Commanders are able to leverage the spectrum manager's advice to provide lethal and non-lethal effects against enemy combat capability, protection from adversary use of the spectrum. SMO supports movement and maneuver through—

- Spectrum resource planning, analysis, and simulation to determine spectrum supportability over a projected movement of forces.
- Analysis, location, and direction finding of unknown and unplanned signals.
- Planning and simulating spectral use over the operational area.
- Frequency deconfliction planning over a movement.

INTELLIGENCE

3-2. The intelligence warfighting function is the related tasks and systems that facilitate understanding of the enemy, terrain, and civil considerations. It includes tasks associated with information collection. SMO supports intelligence through the provision of spectrum situational understanding and the ability to gain a greater understanding of the EMOE. This understanding occurs through the successful frequency deconfliction of SDD, greater fidelity in threat recognition, and support to the denial and destruction of adversary counter-intelligence, counter-surveillance, and counter-reconnaissance systems. SMO supports intelligence through—

- Measurement, analysis, and assessment of spectrum situational awareness.
- JRFL production and promulgation to protect intelligence operations.
- Centralized databases facilitate planning requirements and assessing collection through subordinate and adjacent units.

FIRES

3-3. The fires warfighting function is the related tasks and systems that provide collective and coordinated use of Army indirect fires, air and missile defense, and joint fires through the targeting process (ADRP 3-0). It includes tasks associated with integrating enemy counter mission command activities. SMO provides crucial support to the fires warfighting function through the ability to discriminate friendly forces from adversary targets, increased spectrum awareness, and direct support to EW.

3-4. Electromagnetic environmental effects influence the operational capability of military forces, equipment, systems, and platforms. Spectrum managers support the fires warfighting function by mitigation of interference and ensuring systems are compatible. Hazards of electromagnetic radiation to personnel

(HERP), hazards of electromagnetic radiation to ordnance (HERO), and hazards of electromagnetic radiation to fuels (HERF), are examples of electromagnetic environmental effects.

3-5. A **hazard of electromagnetic radiation to personnel** is the potential hazard that exists when personnel maybe exposed to a radiation field of sufficient intensity to heat the human body. Radar, communication systems, and EW systems that use high-power transmitters and high-gain antennas represent a hazard to personnel working on, or near these systems. Leaders should ensure areas are clearly marked off to avoid injury to personnel.

3-6. A **hazard of electromagnetic radiation to ordnance** is the danger of accidental activation of electro-explosive devices or otherwise electrically activating ordnance because of the radio frequency fields. This unintended actuation could cause premature firing of ordnance.

3-7. A **hazard of electromagnetic radiation to fuels** is the potential hazard that exists when volatile combustibles, such as fuel, exposed to radiation fields of sufficient energy may cause ignition. The hazard is likely to occur when refueling operations are taking place. Leaders must adhere to proper grounding and static discharge procedures. Cease or minimize transmissions during refueling operations to prevent the potential hazard and exposure to radiation fields.

3-8. SMO supports fires through—

- Coordination of the EMOE to prevent EMI to firing devices, sensors and data links that use the spectrum.
- Coordination with the CEMA element that allows effective use of spectrum resources and EW.
- Integration and synchronization of CEMA by assignment and allocation of spectrum use in joint environments.

Note. Coordinated execution of joint electromagnetic spectrum operations with other lethal and nonlethal operations that enable freedom of action in the electromagnetic operational environment comprises electromagnetic spectrum control. (JP 3-13.1)

SUSTAINMENT

3-9. The sustainment warfighting function is the related tasks and systems that provide support and services to ensure freedom of action, extend operational reach, and prolong endurance. SMO ensures that all spectrum dependent activities necessary for sustainment function properly and with minimal interference. Further, through coordination with EW, SMO contributes to overall sustainment in a hostile EMOE. SMO supports sustainment through—

- Design and development, acquisition, and distribution of advanced tools that manage the spectrum use.
- Protection of sustainment forces from friendly and adversary use of spectrum in static or mobile environments.
- Obtaining frequency clearance for all devices for the duration of the mission.
- Frequency deconfliction and emissions control procedures in support of sustainment mission command.
- Provides deconfliction within the spectrum to mitigate negative impacts to aircraft survivability.

MISSION COMMAND

3-10. The mission command warfighting function develops and integrates those activities enabling a commander to balance the art of command and the science of control. Mission command emphasizes the centrality of the commander. Commanders exercise mission command through the conduct of the operations process, knowledge management and information management, synchronize information related capabilities, and through the conduct of CEMA, which includes SMO. SMO enhances mission command in light of other spectrum dependent activities (such as jamming and passage of intelligence) through effective spectrum management. In a contested, congested, and competitive EMOE, the mission command function must remain effective. SMO plays a key part in planning and battle management process and enables situational awareness

of the EMOE. Spectrum managers are assigned to aviation units to support mission command. Aviation units require support to flight dispatch elements, and airfield services elements with robust communications requirements. Figure 3-1 shows the relationship between two SMO tools (described in Chapter 5) that support mission command. Many SMO tools can be substituted for the two SMO tools depicted in the graphic. These tools support the commander using the Command Post of the Future.

3-11. SMO supports mission command through—

- Planning and preparing the spectrum in response of a mission.
- Assessment of the EMOE in response to commander's intent.
- Preparation and maintenance of the EMOE database.
- Understanding the impact of a mission on friendly, neutral, adversary, enemy, joint, interagency, intergovernmental, and multinational entities.
- Collecting spectrum information and visualizing this information in quick and easy to understand formats for completion of the COP.
- Control of the spectrum through force tracking and visualization, frequency deconfliction, reprogramming of SDD, and registration of all spectrum users (such as emitters, sensors, and receivers) with the spectrum manager.
- Development of SMO planning and management tools that support the net-centric environment (NCE) and become interoperable with Army and joint task force spectrum users.

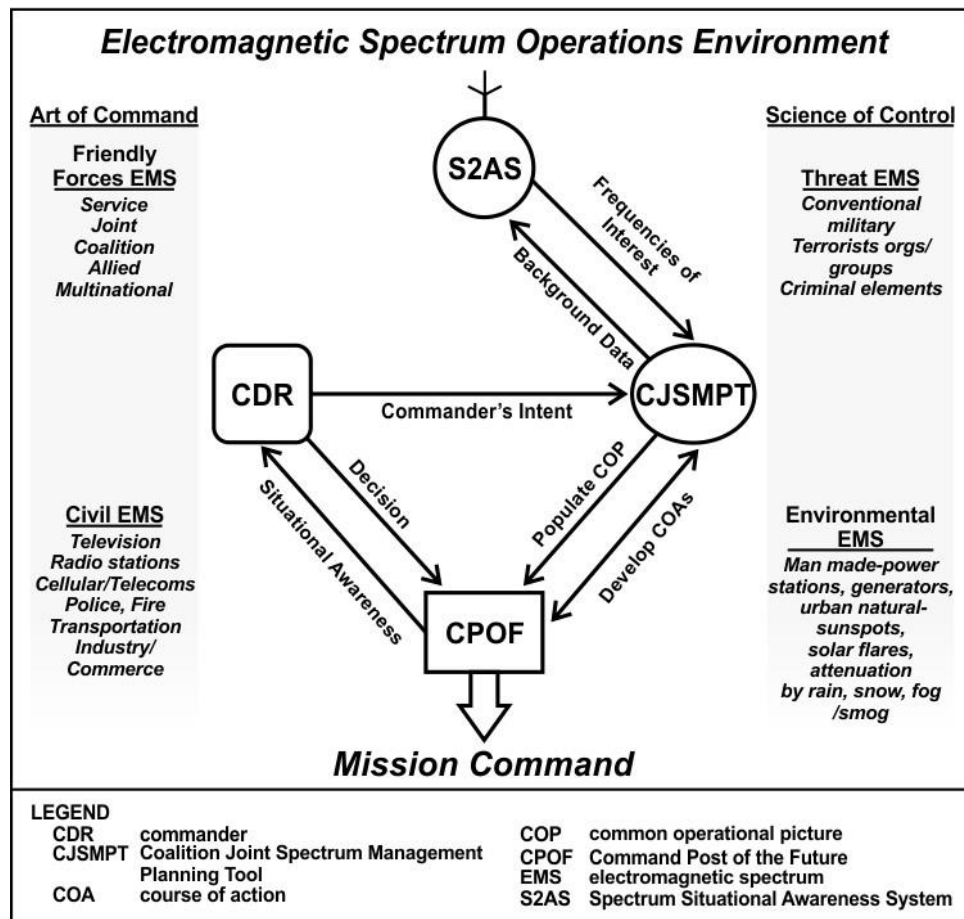


Figure 3-1. Spectrum situational awareness system and CJSMPT support to mission command

PROTECTION

3-12. The protection warfighting function is the related tasks and systems that preserve the force so the commander can apply maximum combat power. SMO supports the protection warfighting function through the conduct of frequency deconfliction, interference mitigation, and support to EW defensive actions. SMO supports protection through—

- Network and frequency fratricide avoidance, detection, and mitigation.
- Development of the JRFL to prevent frequency fratricide and mission degradation.
- Coordination with CEMA Element to protect against blue force EMI during EW operations, such as counter radio-controlled improvised explosive device EW use.

Chapter 4

Joint Task Force Considerations

Modern warfare is inherently a joint operation. Joint operations require precise coordination and establishment of procedures for effective spectrum use. This chapter describes the information and products for planning, coordination, and control of the spectrum at the joint task force level.

INPUTS AND PRODUCTS OF JOINT TASK FORCE SPECTRUM MANAGERS

4-1. Spectrum manager assignments within a joint task force include multiple organizations: JFMO, joint spectrum management element (JSME), CEMA Element and the G-6. These agencies have a wide variety of inputs, collaboration, and products. Figure 4-1 shows a visual description of the spectrum management workflow between organizations in a joint task force environment. The following paragraphs contain an in depth look at the workflow between organizations in a joint task force environment.

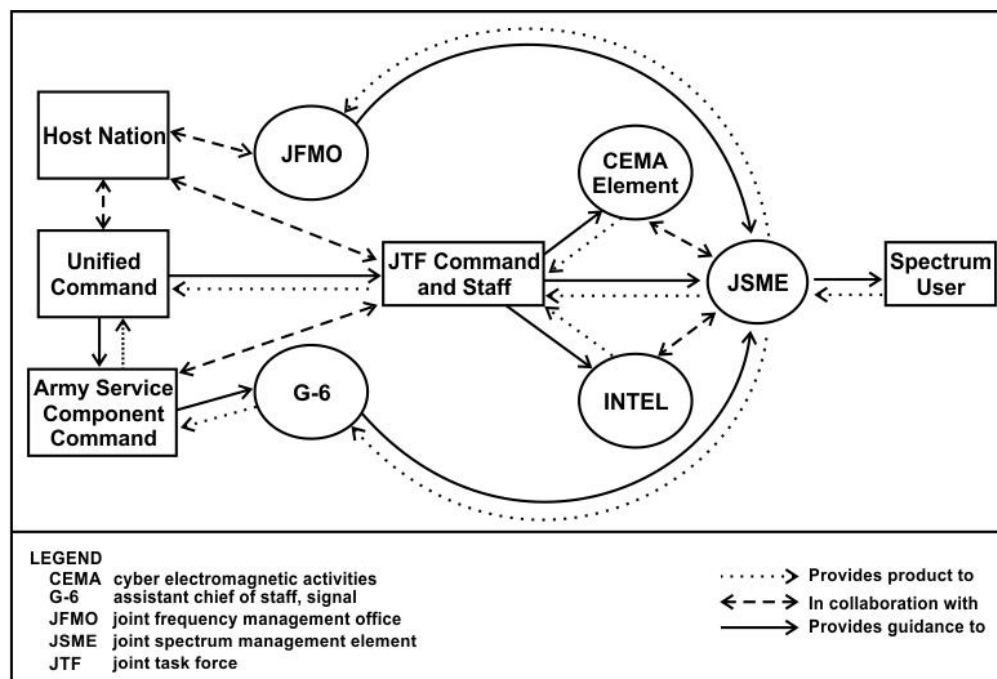


Figure 4-1. Interagency workflow in a joint task force environment

JOINT FREQUENCY MANAGEMENT OFFICE

4-2. The JFMO is a permanent organization within the operational area of a combatant command. The JFMO Chief is a DA civilian. Various personnel focused on region-specific spectrum requirements, staff the JFMO. The JFMO staff size varies, and is dependent on regional requirements. Figure 4-2, on page 4-2, shows the structure of the JFMO.

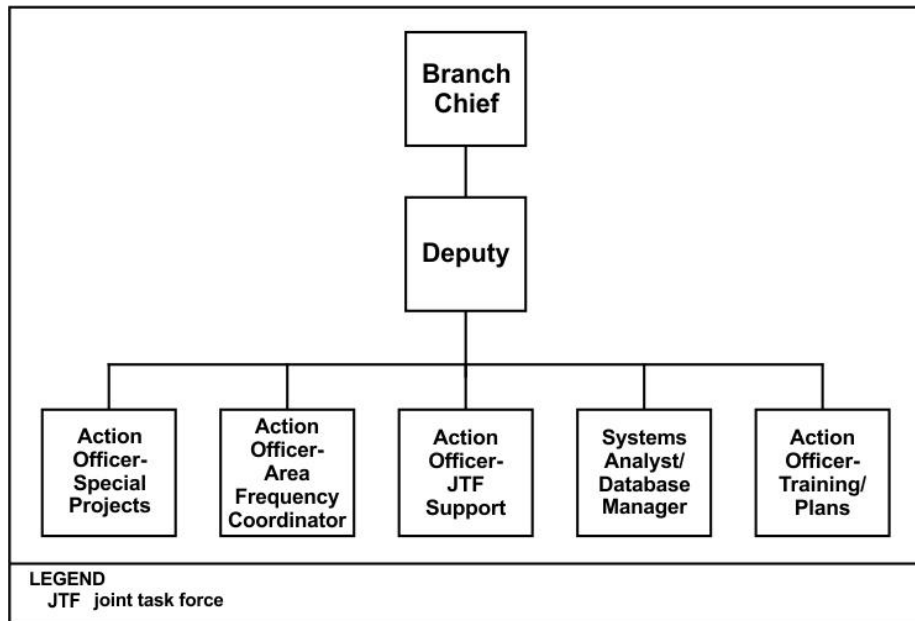


Figure 4-2. JFMO structure

4-3. Table 4-1 shows the inputs to the JFMO by agency. The table provides the agency, the action conducted and the input the agency provides.

Table 4-1. Agency inputs to the JFMO

Agency	Action	JFMO Inputs
Combatant Command	Provides guidance and direction	JCEOI
JTF staff, JSME	Provides	Inputs to develop a JTF JRFL
JSME	Receives	Frequency proposals
Joint staff, civil affairs (J-5), HN	Provide input and responsible for	Host nation frequency authorizations
Spectrum users experiencing EMI	Submit	JSIR report
Legend EMI electromagnetic interference JCEOI joint communications-electronics operating instructions JFMO joint frequency management office JRFL joint restricted frequency list JSIR joint spectrum interference resolution JSME joint spectrum management element JTF joint task force		

4-4. Table 4-2 shows a sample of the products of the JFMO and includes the agency and action taken.

Table 4-2. Products of the JFMO

Agency	Action	JFMO Products
Spectrum users	Provides guidance and direction	Administrative and technical support for spectrum use
JTF staff, JSME, spectrum users	Provides guidance and direction	JCEOI
JTF staff, JSME	Provides guidance and direction	The Spectrum Plan, to include frequency use, reuse, and sharing schemes
JFMO	Provides guidance and direction	<ul style="list-style-type: none"> • Frequency assignments and allotments • Production and management of common spectrum use databases • The JRFL, upon approval from Joint Staff, Operations (J-3) • Mitigation assistance for EMI suffered
Legend EMI electromagnetic interference JCEOI joint communications-electronics operating instructions JFMO joint frequency management office JRFL joint restricted frequency list JSIR joint spectrum interference resolution JSME joint spectrum management element JTF joint task force		

JOINT SPECTRUM MANAGEMENT ELEMENT

4-5. The JSME is a temporary organization that activates only for the duration of a specific joint task force mission. The JSME is an element within the J-6 and is sometimes an entity within a joint network operations control center of a joint task force. The senior spectrum manager may lead the JSME from the lead service of the joint task force. If designated as the joint task force lead, the Army Service component command headquarters, corps headquarters, or division headquarters G-6 spectrum management office assumes the role and responsibilities of the JSME.

4-6. Spectrum management personnel from coalition forces and the sister services augment organizations designated as JSME during deliberate planning using the global force management process. Initial augmentation during the crisis action-planning phase of operations may come from joint enablers such as the Joint Spectrum Center (JSC), the Joint Electronic Warfare Center, or directly from the combatant command, J-6 JFMO. Depending on the size of the force structure supported, JSME end strength ranges from three to ten military service members.

4-7. The JSME has a primary function to ensure authorized assigned joint task force military forces receive sufficient use of the spectrum to execute their designated missions. The JSME satisfies spectrum needs and ensure frequency deconfliction, prior to assignment or allotment, of all SDD including systems used by joint task force and component forces, such as the United Nations, the North Atlantic Treaty Organization, and coalition forces. The JSME provides additional support based on strategic agreements between DOD, the U.S. mission, and the host nation. Table 4-3, on page 4-4, shows the agency inputs to the JSME.

Table 4-3. Agency inputs to the JSME

Agency	Action	JSME Inputs
JTF commander, JFMO	Provide guidance/ direction	JCEOI Guidance
JTF STAFF	Responsible for	Inter service considerations, such as data formats, tools in use, frequency request procedures.
J-6	Provide Guidance / Direction	Nets to be included on the JCEOI
Component Commanders	Receive Guidance / Direction from	Friendly Force Spectrum use requirements and call words for inclusion on the JCEOI
Joint Staff, Intelligence (J-2)	Responsible for	Priority of intelligence gathering requirements
Spectrum Users	Provide Input	JRFL requirements
Spectrum Users Experiencing EMI	Provide Input	JSIR report
JTF Staff and various databases	Provide Guidance / Direction for	Spectrum use information on all friendly military and civilian, available enemy, and neutral forces
Spectrum Users	Responsible for	Requests for frequency authorization, modification, and deletion
JFMO	Provide Guidance / Direction for	Frequency allocations
CEMA ELEMENT	Responsible for	Instances of hostile EW
J-3	Provide Guidance / Direction for	Spectrum user priority
Joint staff, civil affairs (J-5), Host Nation	Provide	Host Nation spectrum authorization
Legend CEMA cyber electromagnetic activities EMI electromagnetic interference EW electronic warfare J-2 intelligence directorate of a joint staff; intelligence staff section J-3 operations directorate of a joint staff J-6 communications system directorate of a joint staff JCEOI joint communications-electronics operating instructions JFMO joint frequency management office JRFL joint restricted frequency list JSIR joint spectrum interference resolution JSME joint spectrum management element JTF joint task force		

Note. Collaboration and coordination with varying agencies, especially host nations, occurs through a variety of processes. These processes are generally very formal and setup through the fostering of mutual trust and rapport between the JFMO and host nation. The spectrum manager must keep in mind customs and cultures, tact and courtesy, and the concerns of other agencies while still attempting to obtain the amount of spectrum resources necessary for the mission. The spectrum manager must also maintain accurate records of all dialogue and agreements made with the host nation.

4-9. Table 4-4 shows some of the products produced by or for the JSME. These products include the data call message, JCEOI, and the spectrum plan.

Table 4-4. Products of the JSME

<i>JSME Products</i>	<i>Action</i>	<i>Agency</i>
The JRFL, upon approval from J-3 and JFMO	Provides Guidance/Direction	Spectrum Users
Data Call Message	Provides Guidance/Direction	Spectrum Users
JSIR assistance	Provides Guidance/Direction	Spectrum Users
Annex K of the OPORD, upon JTF commander approval	Provides Guidance/Direction	Spectrum Users
JSIR report	Disseminates Product	JFMO
Frequency proposals	Disseminates Product	JFMO
Frequency assignments and allotments for stationary units and those on-the-move or at-the-quick- halt	Provides Guidance/Direction	Spectrum Users
The Spectrum Plan, to include frequency use and reuse and sharing schemes	In Collaboration With	JTF Staff, Spectrum Users
JCEOI	Provides Guidance/Direction	Spectrum Users
Frequency usage conflict identification, risk assessment, COA recommendations, and deconfliction	Identified in Collaboration with	CEMA Element
Definition of EMOE	Identified in Collaboration with	Joint Staff
Live spectrum monitoring	Disseminated Product	JTF Commander
Legend CEMA cyber electromagnetic activities COA course of action EMOE electromagnetic operational environment J-3 operations directorate of a joint staff JCEOI joint communications-electronics operating instructions JFMO joint frequency management office JRFL joint restricted frequency list JSIR joint spectrum interference resolution JSME joint spectrum management element JTF joint task force OPORD operation order		

4-10. Figure 4-4 shows the spectrum manager input to the JSME.

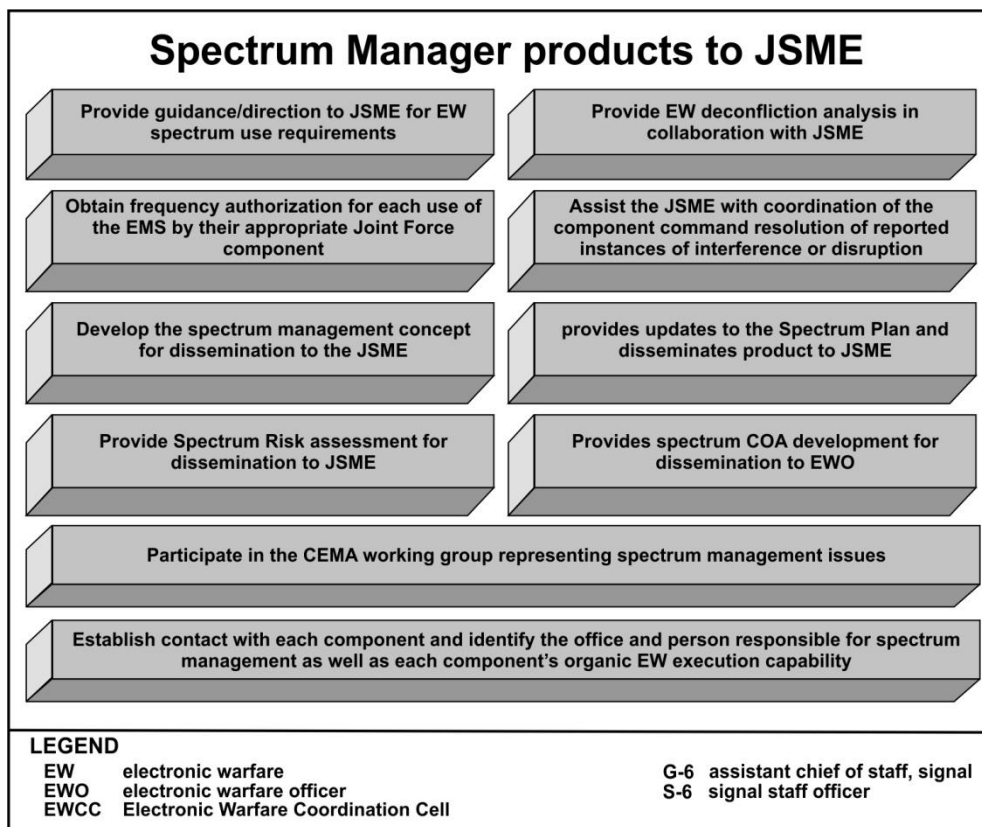


Figure 4-4. Spectrum manager inputs for a JSME

SPECTRUM MANAGEMENT SUPPORT TO DEFENSE SUPPORT OF CIVIL AUTHORITIES

4-11. Army Defense Support of Civil Authorities (DSCA) encompasses all support provided by the components of the Army to civil authorities within the U.S. and its possessions and territories. This includes support provided by the Regular Army, Army Reserve, and Army National Guard when in Title 10 or Title 32 status. United States Code Title 10, Armed Forces, enables the Army to lawfully organize, train, equip, and conduct operations in coordination with other military services, federal departments, and agencies. United States Code Title 32, National Guard, consist of National Guard forces conducting DSCA while under authority of the specific State. Army forces conduct DSCA in response to requests from Federal, state, local, and tribal authorities for domestic incidents, emergencies, disasters, designated law enforcement support, and other domestic activities (ADRP 3-28).

4-12. Spectrum management in support of domestic operations requires liaison with state, municipal, local, and tribal authorities as well as first responders. Spectrum management for domestic operations within the U.S. must comply with a complex legal, regulatory and policy environment. United States Northern Command (USNORTHCOM) and United States Pacific Command (USPACOM) are the principal planning agents for DSCA and have the responsibility to provide joint planning and execution directives for peacetime assistance rendered by DOD within their assigned areas of responsibility. The other combatant commands provide capabilities to USNORTHCOM and USPACOM for DSCA as directed by the Secretary of Defense.

4-13. Various resources may provide spectrum management support when Army forces are operating within the homeland. The separate joint forces headquarters for each state retains responsibility for forces operating within that state or territory. The National Guard (NG) J-6 spectrum management branch is the office responsible for coordinating and planning spectrum management for NG forces and provides support to the

State's spectrum managers for domestic operations. The NG J-6 spectrum management branch provides coordination between the State's spectrum managers and all federal agencies. NG J-6 authorizes state spectrum managers direct liaison with the Army frequency management office or the Army spectrum management office. Joint forces headquarters state spectrum managers form a JSME in support of operational task forces under state active duty, dual status (Title 32 or Title 10) domestic operations.

4-14. Activated forces, after acquiring frequency assignments may operate both civil and military systems within a domestic area of operations to achieve interoperability with other Federal agencies and civil authorities. NG forces may request frequency assignments through the NG, or through Title 10 military channels depending on their duty status for a given operation. The National Telecommunications and Information Administration control the spectrum within the homeland. They certify and license civilian usage of the electromagnetic spectrum. NG forces and U.S. Coast Guard may operate both civil and military systems within a domestic area of operations, as well as numerous states, local and federal agencies.

4-15. After receiving orders to conduct movement for a domestic operation, each operational element initially contacts their local state spectrum manager or JSME for a JCEOI extract detailing the frequencies and procedures to use for communications. The local spectrum manager or the JSME submit a standard frequency action format (SFAF) request for frequencies on behalf of the end user. A state's qualified spectrum manager provides spectrum management for a given geographical state to the greatest extent possible. Spectrum managers coordinate for interstate operations, and for spectrum deconfliction for operations adjacent to another spectrum manager's area of responsibility. Local spectrum managers form the JSME and work directly for the incident commander (or the local state joint force headquarters prior to the appointment of an incident commander).

4-16. Domestic operations lessons learned have demonstrated that both unity of effort and coordinated spectrum management are critical to the success of the operation. Congress and the DOD, through the implementation of a dual status commander (commander of both Title 32 NG forces, and Title 10 NG and active Army forces for a domestic operation) have addressed unity of effort. Unity of command is not applicable between Federal military forces and the state NG, but unity of effort can be achieved if the President and the Governor formally agree to appoint a dual-status commander. Federal authorities have been established that allow a designated dual-status commander to serve in a hybrid Federal and state status. A dual-status commander will usually be a National Guard officer who is given simultaneous but separate authorities over Federal and state military forces. Spectrum management for a domestic operation requires consolidation under one JSME, (or at a minimum coordinated Title 10 and Title 32 JSMEs led by the same commander) to minimize confusion and provide seamless support to tactical communications.

4-17. The JSME initially assigned to an incident continues to work for the incident commander as the operation transitions to a different duty status or legal authority, to ensure continuity of spectrum management. Typically, a state Governor or Adjutant General creates a standing joint task force including a JSME, or establish a joint task force with a JSME in response to an incident. Optionally, each state builds its JSME from qualified spectrum managers, and equipment from within the state National Guard's tables of distribution and allowance allotment. Should a state not have qualified spectrum managers, the Adjutant General and Governor may request qualified spectrum managers prepare to deploy from other states to form a JSME under a formalized emergency management assistance compact. The JSME may request a spectrum flyaway team from the NG bureau J-6 and USNORTHCOM to supplement the element.

4-18. Figure 4-5, provides a graphic of the collaboration process during domestic operations.

Note. See JP 3-28 and JP 6-01 for more information regarding domestic operations.

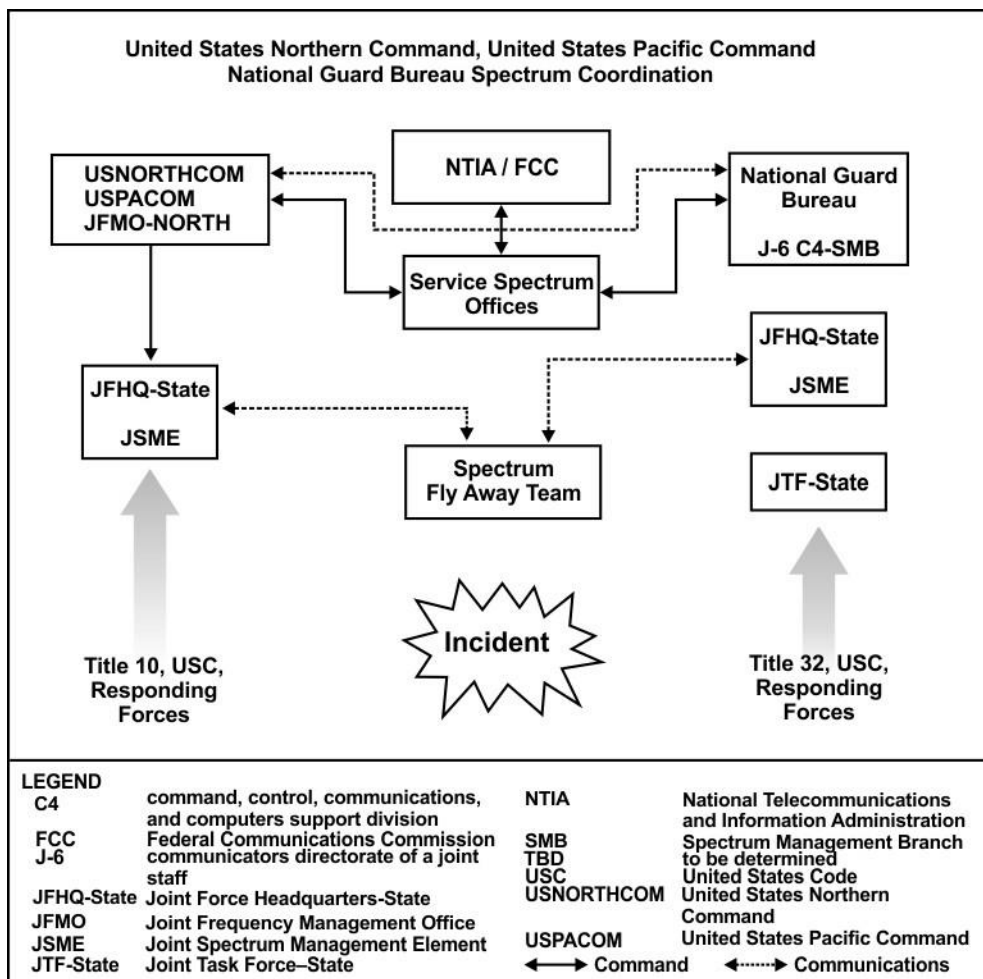


Figure 4-5. Spectrum management support during domestic operations

Chapter 5

Spectrum Management Operations Tools

Spectrum managers have access to a wide variety of tools to aid in effective and efficient spectrum planning and management. This chapter provides a technical description of several tools used to facilitate spectrum management operations. Included in this chapter are hardware and infrastructure requirements, software used, and capabilities of spectrum management tools.

TOOL CONSIDERATIONS

- 5-1. There are a variety of spectrum related tools used to plan and manage communications networks and SDDs. Many of these tools do specific functions of limited scope precluding the sharing of relevant information among these functions creating inefficiencies. This can lead to erroneous planning and assignments that can cause frequency interference. It is essential for the benefit of all spectrum stakeholders, tools should share data in a consistent manner to improve efficiencies. As an example, EW operators should use the same tool that the spectrum manager uses in order to allow the spectrum manager to mitigate harmful interference to friendly systems possibly caused by EW systems.
- 5-2. Gathering and managing spectrum data requires considerable time in order to ensure accuracy. Tools that support the automation of spectrum management functions can drastically reduce this time constraint. Tools that promote the flow of information between spectrum stakeholders reduce the planning cycle leading to quicker decisions. Spectrum managers are able to perform the core SMO functions much more efficiently when tools comply with the net-centric environment.
- 5-3. The NCE, a common shared virtual space used within and among differing authenticated units and organizations, has facilitated numerous advantages for spectrum managers of all levels. Central access to multiple databases reduces or eliminates the need to visit agencies to obtain a list of devices used in the area of operations. Having central databases requires SMO tools to have interoperable and compatible formats in order to function. The net-centric environment is very effective in joint task force operations.
- 5-4. There exist many data file standards regarding frequency proposals. Standard Frequency Action Format (SFAF) is a line oriented text format used by DOD, and by U.S. allies and unified action partners who use Spectrum XXI. SFAF is the standard format for frequency proposals, assignments, modifications, renewals, reviews, and deletions.

SPECTRUM SITUATIONAL AWARENESS SYSTEM

- 5-5. The Spectrum Situational Awareness System (S2AS) is theater provided equipment used to assist in maintaining effective use of the spectrum. The S2AS provides fixed site and portable spectrum-monitoring receiver that performs instantaneous analysis of captured spectrum data. The S2AS consists of government off-the-shelf software referred to as multi spectral ambient noise collection and analysis tool (MANCAT) and commercial off-the-shelf hardware Rohde & Schwarz PR100 monitoring receiver and ancillary antennas. The S2AS requires the unit to provide a computer to run the software and a global position location device. The system comes with a ruggedized carrying case that protects the PR100 and HE-300 antenna while in transit. Figure 5-1, on page 5-2, shows the components that comprises S2AS.

Note. An upgrade to the HE-300 antenna is available that includes a built in global positioning system location device and electronic compass. This capability, in conjunction with an available software update for the PR100, allows for rudimentary direction finding of signals and triangulation between multiple S2AS users and measurements. The S2AS provides direction-finding antenna and triangulation capability intended for post, camp, or forward operation base locations. System use of S2AS is for a relatively small area. This upgrade also eliminates the need for a unit provided global positioning system receiver.



Figure 5-1. S2AS and supporting equipment

5-6. The advantages of a monitoring receiver over a traditional spectrum analyzer are its rapid precision measurements and analysis of spectrum over a wide bandwidth. The monitoring receiver provides the measured spectrum to the MANCAT software for automated analysis. The PR100 can operate on 100 to 240 volts alternating current and comes with a wide variety of connectors to allow for connecting to differing voltage sources around the world. The PR100 also has an easily removable and rechargeable battery with an approximate lifespan of 3.5 hours.

5-7. When used with a location device, S2AS allows for mobile measurements of the spectrum. For example, the spectrum manager can take S2AS on a convoy route to measure persistent signals that are in use in the area. The location device senses the grid coordinates of the route for mapping captured signals by other tools (Global Electromagnetic Spectrum Information System [GEMSIS] and MANCAT). When imported, Google maps provide the software overlays with a color-coded spectrum map over a three-dimensional digitally mapped terrain to support the COP. Figure 5-2, on page 5-3, depicts Soldiers operating the direction-finding antenna and the PR-100 handheld receiver.



Figure 5-2. S2AS in use by Soldiers

5-8. The S2AS provides a fast panoramic scan across the frequency range of 9 kHz to 7.5 GHz. This enables Soldiers to quickly access the spectrum and begin to incorporate data into the required database. The display on the device provides a spectrum and spectrogram display which users of the spectrum analyzer may be familiar with on a portable 6.5" color screen. The unit provides storage of measurement data to the receiver's built-in storage card. The PR-100 design is ergonomic and rugged for portable use and low weight. The device has a setting for manual location of spectrum emissions using the active directional antenna or automatic location of spectrum emissions with direction finding algorithms.

5-9. The operator of the S2AS can save spectrum measurements in comma-separated value format and spectrum screenshots in portable network graphics format. MANCAT software exports reports in PDF, HTML, JPEG, or TIFF formats.

5-10. The S2AS includes a continuous band antenna that is vehicle mounted or fixed to a tripod stand for measurements of spectrum from 30 to 6000 MHz. The system includes a handheld HE-300 antenna with three interchangeable modules for the 20 MHz to 7.5 GHz ranges and the HE-300HF module for high frequency ranges from 9 kHz to 20 MHz. Antenna HE-300 provides the capability to perform direction finding of unplanned signals in specific frequency ranges. S2AS is compatible with some antennas that units may already have, including the SINCGARS vehicle whip and the OE-254 antenna.

5-11. The S2AS standard package can measure and analyze signals from 20 MHz to 7.5 GHz with the included continuous band antenna and HE-300 antennas. This range encompasses the majority of spectrum conflicts the spectrum manager encounters. An upgrade package, that expands the range to 18 GHz, is available for users that need to analyze higher frequencies, but cost is an issue for users that do not regularly analyze those frequencies.

5-12. S2AS uses standard data formats compatible with CJSMP, GEMSI and Spectrum XXI. Once the captured signals are available in the CJSMP or Spectrum XXI tools, the spectrum manager can update known databases. The MANCAT software allows the user to import frequencies of interest from planned databases, such as Spectrum XXI, and provide a visual display to the operator of planned or known signals.

5-13. S2AS visually differentiates signals that are not in any planned database so that the spectrum manager can further investigate the source of the signal. Figure 5-3 shows the functional relationship between the S2AS key capabilities. The figure provides a graphical depiction of the sense characteristic. Sensing and monitoring frequencies that are available to the user is an initial operational function of the S2AS. The system then analyzes the information captured and shares the data with the listed database.

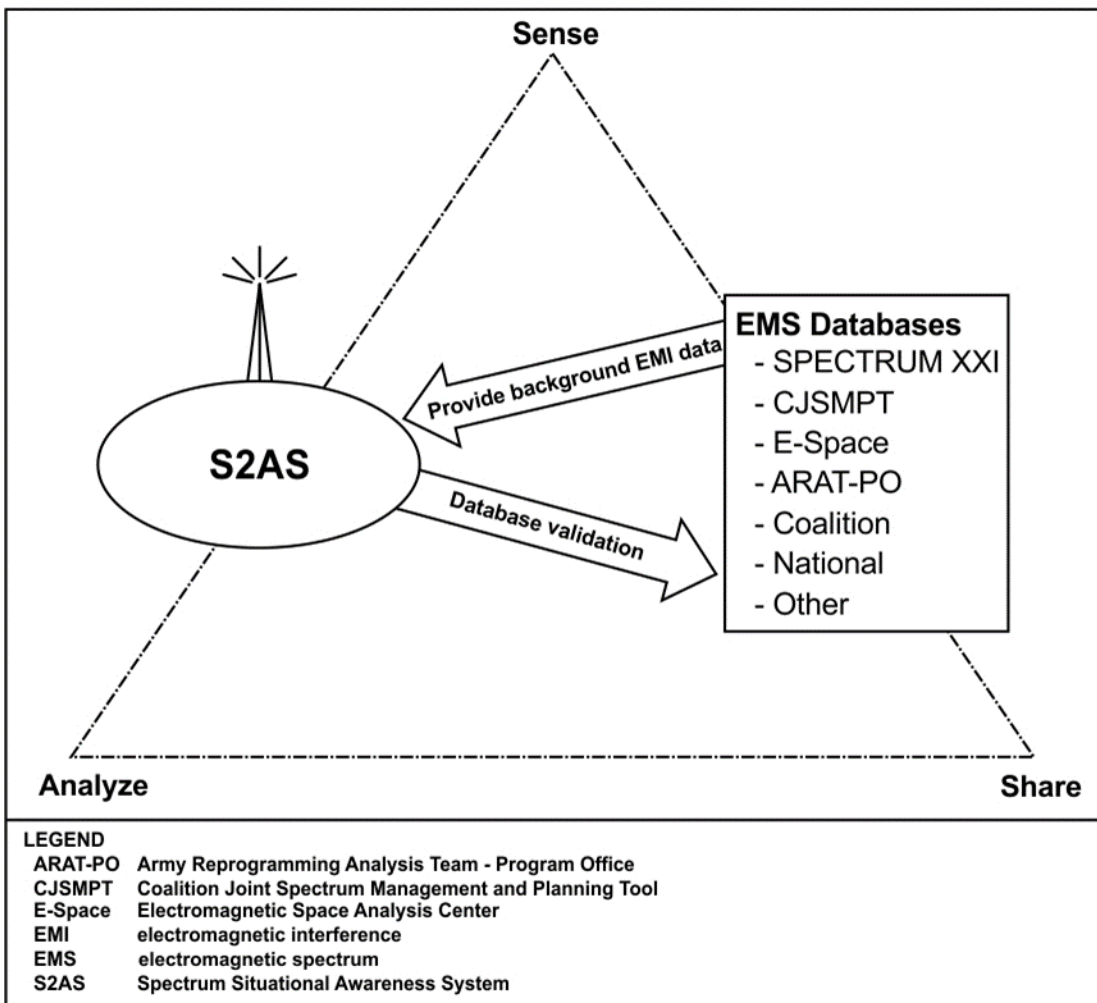


Figure 5-3. S2AS functional relationships

GLOBAL ELECTROMAGNETIC SPECTRUM INFORMATION SYSTEM

5-14. Global Electromagnetic Spectrum Information System (GEMSIS) is a joint program of record that provides access to several spectrum management tools. Spectrum managers access GEMSIS on the internet via NIPRNET and SIPRNET connections. GEMSIS increases the effectiveness of the COP, accelerates spectrum access, increases interoperability, and support to NCE. GEMSIS increment 2 incorporates other SMO tools, such as CJSMP, Spectrum XXI-Online, systems planning, engineering, and evaluation device (SPEED), and Afloat Electromagnetic Spectrum Operations Program (AESOP) as an effort to further transition spectrum management to a NCE compliant and provide all the needed capabilities to the spectrum manager in one central tool.

5-15. GEMSIS provides worldwide visibility of host nation supportability of SDD equipment. The system automates distribution of host nation coordination requests and Combatant command submission of host nation supportability comments. This enables spectrum managers to determine the historical supportability of other systems in the same frequency band.

COALITION JOINT SPECTRUM MANAGEMENT PLANNING TOOL

5-16. Coalition Joint Spectrum Management Planning Tool (CJSMPT) is a capability delivered by the GEMSIS program. CJSMPT developed as a joint capability technology demonstration that integrates spectrum management, modeling, simulation, and planning tools that enables spectrum managers at all levels (joint task force and below) to perform spectrum planning and frequency deconfliction for mission planning and combat operations.

5-17. CJSMPT provides the capability to predict interference as units move across a simulated EMOE. CJSMPT uses this simulation to perform deconfliction analysis that is compatible with EW operations and future rapid maneuvering forces. This means that the spectrum manager can simulate and visualize a unit's movement, perform spectrum interference analysis and frequency deconfliction, and provide recommendations to the commander for complete spectrum use during the movement.

5-18. The CJSMPT database is the spectrum knowledge repository. CJSMPT is compatible with S2AS and Spectrum XXI using common data formats. The map manager functional area of the software allows the user to import any national geospatial-intelligence agency map resource. The spectrum data repository provides users with a single authoritative data source of known databases, such as joint, equipment, tactical, and space.

5-19. CJSMPT performs spectrum optimization and conflict mitigation using environmental factors, operational priorities, frequency allocation and assignments, and international spectrum management policies and regulations. The main visualizer panel within CJSMPT displays spectrum use in a color-coded two and three dimensional picture that is available throughout the mission's duration. CJSMPT enables the spectrum manager to provide the commander with accurate spectrum information for civil (grey), hostile (red), friendly (blue) and counter radio-controlled improvised explosive device EW, referred to as CREW, and Intelligence operations on blue force SDDs.

5-20. CJSMPT allows the operator to submit frequency proposals to the Spectrum XXI system using the SFAF and standard spectrum resource format compliant formats. Upon approval by Spectrum XXI, CJSMPT can import frequency assignments into the spectrum knowledge repository. CJSMPT can automatically format a satellite access authorization into the appropriate format (SFAF) saving the spectrum manager time.

5-21. The spectrum requirements advisor utility within CJSMPT automatically generates spectrum reuse plans and calculates the minimum spectrum requirements for an interference free operation over a given movement of forces. This allows for rapid force movement while minimizing the spectral impact of a mission. CJSMPT can generate formatted reports, such as the joint spectrum interference resolution (JSIR) report, based on the communications effects simulator utility. The operator can save detailed reports in extensible markup language (XML), HTML, or comma separated values formats. Spectrum planning within CJSMPT can account for bandwidth, frequency locking, guard bands, and frequency allocation tables.

5-22. CJSMPT allows the spectrum manager to develop scenarios quickly by placing forces into the database using force templates. Force templates within CJSMPT include force structure, SDDs characteristics, and spectrum usage information for devices that have passed the spectrum certification process. CJSMPT allows the user to place device characteristics into the database for devices that have not received spectrum certification. Without this capability, the spectrum manager must manually place force structure and SDD characteristics into a variety of locations, such as XML spreadsheets. Manual input can cause data format inconsistencies, possible human error, and time delays.

5-23. CJSMPT functions in a NCE by granting network access through SIPRNET. Users perform peer-to-peer collaboration and retrieve information from the master spectrum knowledge repository while connected to the SIPRNET. CJSMPT also provides support to joint task force environments by providing features targeted to key joint task force agencies. JFMO and JSME agencies develop and maintain the JRFL and JCEOI, which resides over the spectrum knowledge repository database for the area of responsibility. Spectrum managers assigned to the JFMO or JSME control and update the spectrum knowledge repository with specific locally operated equipment and identify the effects of EW on emitter devices.

5-24. The CJSMPT administrator, serves as the overall oversight of the CJSMPT database by maintaining force structure and equipment, control of the master spectrum knowledge repository, and updating a detailed

list of known SDD worldwide. CJSMP functions in a standalone environment to operate while not connected to the SIPRNET.

SYSTEMS PLANNING, ENGINEERING, AND EVALUATION DEVICE

5-25. The systems planning, engineering, and evaluation device (SPEED), developed as United States Marine Corps government off the shelf software. SPEED is a modular software application that provides modules that target user specific needs. SPEED allows the spectrum manager to complete and edit SFAF forms while using an equipment database that includes tactical platforms, equipment, and antennas. The Asset Manager module within SPEED provides the capability to import, export, build vehicle manifests, personnel rosters, and equipment deployment lists. SPEED is free to all federal agencies but primarily used by the United States Marine Corp communications and spectrum managers. Army spectrum managers may interface with SPEED in joint operations.

5-26. SPEED provides both two and three-dimensional views of the operational area to support the COP. The Advanced Prophet and Terrain Integrated Rough Earth Model and National Geospatial Intelligence Agency provide map data to the system. SPEED provides the user with a color-coded display of spectrum use over the operational area. SPEED can generate JRFL input in the correct format to the next higher echelon. The system allows the user to manually input, store, and view information for a tactical satellite network defined in a satellite access authorization, but cannot automatically format the authorization into the SFAF or standard spectrum resource format (SSRF). SPEED is a software package that is distributed with the automated communications engineering software or joint automated CEOI system image on the unit provided AN/GYK-33 computer.

AFLOAT ELECTROMAGNETIC SPECTRUM OPERATIONS PROGRAM

5-27. AESOP is an integrated operational radar, combat system, and communications frequency-planning tool primarily used by U.S. Navy and U.S. Coast Guard spectrum managers. This tool calculates optimal frequency use and distance separation that considers all strike group SDDs. AESOP minimizes electromagnetic interference in accordance with national and international frequency regulations. The strike group staff or designated frequency coordinator can select frequencies and separation distances for the group's ships to ensure that the radars operate with a minimum of electromagnetic interference.

5-28. In addition to the ships of the U.S. Navy, AESOP contains data from fleets of over 60 countries. AESOP supports radar and communication analysis and spectrum planning for joint warfare operations on platforms for the following—

- Ships.
- Submarines.
- Aircraft.
- Military and civilian ground sites.

5-29. AESOP periodic updates have improved the performance of communications networks in the presence of counter radio-controlled improvised explosive device electronic warfare and other EW. The AESOP master database is shore based and is only available via connection to the SIPRNET. For users with no access to SIPRNET or having limited bandwidth, AESOP is available in a standalone mode with a local database.

5-30. AESOP is compliant with the SFAF and SSRF. Measurements taken by AESOP provide input and development of the DD Form 1494. AESOP provides spectrum visualization after analysis of spectrum use. AESOP can import and export XML files. The system can provide the Navy's input to the JRFL during joint task force operations. Army spectrum managers may interface with AESOP when coordinating spectrum use in operational areas collocated with Navy missions.

SPECTRUM XXI

5-31. Commanders have several configuration options within Spectrum XXI. Spectrum XXI is a client and server, Windows-based software system that provides spectrum managers with a single information system that addresses spectrum management automation requirements. The JSC manages Spectrum XXI. Spectrum XXI supports operational planning as well as near instantaneous management of the electromagnetic

spectrum with an emphasis on assigning compatible frequencies and performing spectrum-engineering tasks. Spectrum XXI client version is a software package that requires a unit funded computer.

5-32. The joint spectrum center central repository for Spectrum XXI provides the DOD with a central database that contains spectrum certification for compliant systems, topography and electromagnetic environmental effects data, and all DOD spectrum proposals and assignments. The repository also serves as the mechanism to transfer data between the DOD and NTIA for permanent frequency assignments in the U.S. and its possessions. Spectrum XXI users may access the government master file through the central repository as needed.

5-33. Spectrum XXI users can connect to one of the three regional servers through local area network access, SIPRNET access, or secure telephone for dial-up access. The Spectrum XXI database uses the Oracle database management system based on structured query language that requires licenses and training for the regional servers. The client version that Army spectrum managers use does not require an Oracle license or training. The client can function in standalone mode using the local database with limited functionality when network connectivity is unavailable. Spectrum XXI contains a table of International Telecommunications Union allocations by region to aid the spectrum manager in international spectrum planning compliance. The Spectrum XXI database also contains geographical boundaries and utilities. The system can plot SDD based on frequency records.

5-34. Spectrum XXI allows the user to create and maintain permanent, temporary, proposed assignments, including background on frequency assignments. Spectrum XXI analyzes frequency assignments for operating conditions, interference, intermodulation, allocation and allotment tables, and compliance with technical and administration standards. A simulated spectrum analyzer provides a display of current spectrum occupancy and projected spectrum use at user-defined sites.

5-35. Spectrum XXI allows for the creation of the JSIR to aid in the mitigation of EMI. The system also creates and manages input to the JRFL. Spectrum XXI can analyze the impact of EW on spectrum users. Spectrum XXI is compliant with the SFAF as outlined in the MCEB Publication 7 format.

Spectrum XXI Key Components

5-36. This section provides readers with information on the various components of the Spectrum XXI software. The modules described in this section are a small sample of the capabilities of what Spectrum XXI provides to commanders and leaders.

5-37. **Interference Analysis Module** analyzes existing frequency assignments for potential interference. This analysis, is normally performed when the holder of a frequency assignment reports interference from an unknown station. An interference analysis maybe accomplished to determine whether a transmitter on a single frequency would potentially cause interference to an existing environmental receiver represented by a frequency record in the database. The interference analysis module performs analysis to determine if a receiver potentially receives interference from an existing environmental transmitter represented by a frequency record in the database.

5-38. **Interference Report Module** generates interference reports that describe interference problems and provides information to resolve the problem. Interference reports can also document a history of problems, and thus identify possible causes for subsequent interference. If interference problems exist, the first step as a spectrum manager is to verify that the person reporting the interference has authorization to use that frequency. Spectrum managers attempt to resolve interference problems at the lowest level possible. If this is not possible, create a report for distribution to higher authorities. If a resolution is not found, the interference information is reported to the unified or specified command (usually the combatant commander or the service representative) who then may call upon the JSIR team (as part of the JSIR program located at the JSC) to investigate.

5-39. **EW Deconfliction Module** assesses the impact of a planned electronic attack and jamming on existing receivers during contingency operations and exercises. The joint staff, operations must know the operational situation to make intelligent decisions when using this module. The EW Deconfliction Module, used in conjunction with the JRFL Module, documents a list of frequencies protected from jamming. In addition, the module analyzes the impact a frequency jammer has on environmental receivers using a range of azimuths. Analysis results comprise three types of conflicts—

- Frequency assignment conflicts.
- JRFL conflicts.
- Communications-Electronics Operating Instructions conflicts.

5-40. The Joint Restricted Frequency List Module is a management tool used by various operational and support elements to identify the level of protection they desire, applied to specific spectrum, to preclude these assets from being "jammed" by friendly forces conducting electronic warfare activities. The JRFL identification and building process begins at the unit level, works upward through the military services' chain of command, then consolidated within the combatant command or joint task force staff. The module allows users to select frequency assignment from Spectrum XXI or JCEOI nets. Selecting these frequency assignments is done by importing the generated CEOI in the JRFL module.

5-41. The **Engineering Tools Module** is a collection of utilities used to perform several types of analyses—

- **Coordinate Conversion:** This utility provides a graphical representation of the conversion between latitude, longitude, and military grid coordinates.
- **Co-site Analysis:** Used to perform co-site analysis on a list of frequencies and emissions.
- **Coverage Plots:** Used to create terrain elevation plots, line-of-sight plots, and signal strength plots. This function provides the commander analytics help determine the best placement of sensors.
- **Geomagnetic Conversion:** The Geomagnetic Conversion utility converts magnetic azimuths to true azimuths.
- **High Frequency Skywave Analysis:** The High Frequency Skywave Analysis utility calculates the high frequency skywave, propagation prediction values for the maximum usable frequency, the frequency of optimum transmission, and the lowest usable frequency based on the time of day between a transmitting and receiving location.
- **Point-to-Point Link Analysis:** The Point-to-Point utility displays the terrain profile and aids in determination of the viability of radio links between transmitting and receiving locations.
- **Satellite Look Angles for Multiple Earth Stations and Multiple Satellites:** Used to calculate the azimuth and take-off (elevation) angle from earth stations to geostationary satellites.
- **Spectrum Occupancy:** Used to display a graphical representation of the calculated received signal power at a specified location indicated in the frequency records of the assignment database (this is similar to the view seen on a spectrum analyzer).

5-42. The **Topographic Manager Module** is an automated capability that reformats the level-1 and level-2 digital terrain elevation data obtained directly from the National Geospatial-Intelligence Agency on compact disk-read only memory disks. The Topographic Manager can register and manage reformatted topographical data files.

5-43. The **Frequency Assignment Module** automates the processing of requests for the use of frequency resources from spectrum managers in support of authorized users. The process includes the preparation of frequency assignment proposals, validation of those proposals, determination of possible interference with the background environment, distribution and status tracking of proposals. The Frequency Assignment module also provides processes for frequency assignment database updates and retrievals.

5-44. The **Allotment Plan Generator Module** creates a list of frequencies commonly referred to as Allotment Plans, Channelization Plans, Spectrum Use Plans, or Radio Frequency Authorizations. These plans are a frequency resource for nominating proposals using the Frequency Assignment module. In some cases, allotment plans disseminate authorized temporary frequencies used for training or tactical exercises.

5-45. The **Compliance Module** checks the format and content of frequency records saved to a file and are not in the proposal editor. Three types of compliance checks may be performed: allocation table checks, Canadian and Mexican coordination checks, or field validation checks. You also have the option to perform all checks. The record source for your records determines which validation checks are performed. International users should use the Validation option only.

5-46. **Spectrum Certification System** is an automated system used to prepare a DD Form 1494, Application for Equipment Frequency Allocation, at frequency management offices that support materiel acquisition.

5-47. The **Data Exchange Module** electronically exchanges data between servers and client computers. The Data Exchange Module manages the server accounts, job accounts, and domains used for data exchanges. A stand-alone client (not network connected) cannot use the functions of Data Exchange. When first installed, Spectrum XXI is a stand-alone client until the initial connection to a server. When connected it becomes a data-exchanging client.

HOST NATION SPECTRUM WORLDWIDE DATABASE ONLINE

5-48. The Host Nation Spectrum Worldwide Database Online (HNSWDO) is a web application that facilitates warfighter deployment and communications by providing worldwide visibility of host supportability of SDD. The HNSWDO automates the distribution of host nation coordination requests allowing combatant command submission for host nation supportability, reducing time requirements for managing the host nation spectrum authorization process. The design of the database provides informed decision making concerning frequency bands. This mitigates the risk of acquiring potentially unsupportable systems. HNSWDO provides the user with near instantaneous updates and dramatic reductions in process lag (from years to months). HNSWDO requires an approved account and NIPRNET access using a unit provided laptop computer. The Defense Spectrum Organization processes account request.

Note. Host nation allocation tables and SDD certification does not constitute the authorization to assign frequencies within the host nation. Send all formal frequency requests to the host nation to obtain frequency authorization. See JP 6-01 for more information on host nation coordination.

AUTOMATED COMMUNICATIONS ENGINEERING SOFTWARE AND JOINT AUTOMATED COMMUNICATIONS ENGINEERING SOFTWARE

5-49. Automated Communications Engineering Software (ACES) and Joint Automated Communications Engineering Software (JACS) are part of the Army key management system that automates the management of communications security (COMSEC) keys, electronic protection (EP) data, and SOI. These multipurpose programs reside on a laptop computer. Key features of the software for SMO purposes are SOI generation, viewing and printing, EP identifiers, transmission security keys, data generation, creating loadsets for SINCGARS and SINCGARS compatible radios and electronic distribution of the joint automated communications-electronics operation instructions system.

5-50. ACES and JACS integrate secure network planning, EP distribution, and SOI generation and management. The workstation functions in conjunction with the data transfer device, hosting tier 3 software, to automate cryptographic control operation for networks with electronically keyed COMSEC equipment.

5-51. The resident software components on the ACES or JACS workstation include the following—

- General purpose module.
- Core module.
- Area common user system module.
- Resource manager module.
- Master net list module.
- Signal operating instructions (SOI) module.
- Combat net radio module.
- ARC-220 Module
- Satellite Communications Module

General Purpose Module

5-52. The general-purpose module provides the information and operations necessary to satisfy the planning requirements for cryptonets that operate independently of area common user systems and combat net radio networks. It allows the planning capability for manual key assignments for compatible COMSEC equipment in an operator-designed cryptonet configuration. It allows for the importing of the Black Key packages from the local COMSEC management system.

Area Common User System Module

5-53. The area common user system module lists information that encompasses both Joint Network Node equipment and echelons above corps networks. The module contains procedures for creating and drawing an area common user system backbone network and creating and drawing network extensions. It also describes the procedures required to validate and generate area common user system networks, and modify area common user system member properties.

Resource Manager Module

5-54. The resource manager module contains the list of available frequency resources and allows creation, editing, merging, deleting, and printing of these resources. Each frequency resource is described by attributes that specify the authorized use and location of all the frequencies contained within the resource. The resource module also provides planners the capability to import and export resources in JACS, Integrated System Control, and SFAF formats.

Master Net List Module

5-55. The master net list module provides a communications list containing the net name or description, net identification, organizational code, restrictions, frequency type, power, reuse class, reuse zone, and call word or color word requirements. The master net list is developed for an operations plan. The master net list module provides the capability to create, edit, merge, delete, and print nets. The master net list module incorporates a number of SFAF-compatible fields to facilitate the transfer of data to and from other frequency management systems such as Spectrum XXI, as well as service unique systems. The database capabilities of the workstation allow the data in the master net list to create the initial SFAF frequency proposal and the SOI.

SOI Module

5-56. The SOI module contains call signs, call words, frequency assignments, signs and countersigns. The SOI module also contains pyrotechnic and smoke signals, dictionaries, groups, quick reference, and title pages. Generation of pyrotechnics and smoke signal components may be separate or randomly selected. SOI also provides the capability to create the Master Call Sign packets, as well as separate extract packets, while maintaining a database link to nets in the master net list.

Combat Net Radio Module

5-57. The combat net radio module provides the necessary functions to create, modify, and generate hopsets or loadsets for SINCGARS transmission security keys. It also provides the capability to plan combat net radio nets in all bands. Combat net radio network planning provides integration with the master net list module. Loadsets are packages of frequency hopping data and COMSEC keys required to load up to six channels of the SINCGARS radios. One loadset consists of COMSEC keys tags, hopsets, lockouts, transmission security keys and net identifiers. Hopsets consists of a set or sets of resources converted into SINCGARS useable frequency hopping data. The complexity of the hopset may be directly related to the amount of memory needed in the receiver-transmitter. Hopset resources maybe constructed with minimal pattern interruption, as the radio is frequency hopping at a rate of 100 channels per second. Lockouts are digitized hopset data generated and stored in the combat net radio. Lockouts electronically map all available frequencies by relaying to the radio's memory frequencies it cannot use. This deliberately disables unused frequency channels, avoiding interference with another service.

ARC-220 Module

5-58. The ARC-220 module allows platforms and equipment assignment to ARC-220 nets. ARC-220 is a radio network that supports long-range communications between military aircraft and ground stations. This network type provides support for the AN/ARC-220 (aircraft version) and AN/VRC-100 (ground version) radios. These radios operate in three different modes: single channel (Basic Preset or Manual), automatic link establishment, and electronic counter-counter measure. The net validate function ensures that the platforms intended to communicate with each other can in fact do so with the equipment they have been allocated. The net generated function automatically creates COMSEC key tag assignments to secure the network.

Satellite Communications Module

5-59. The satellite communications module allows the operator the capability to support the crypto planning for two of the Army's satellite communications terminals. These terminals are the Single Channel Anti-Jam Man Portable Terminal and the Secure Mobile Anti-Jam reliable Tactical Terminal. These satellite systems operate at radio frequencies in the extremely high frequency range.

5-60. The network planning functionality of ACES or JACS incorporates cryptonet planning, key management, and key tag generation. The planning concept relates to the development of network structures supporting missions and plans. The data for a given plan includes individual nets, and assigned individual net members. Net members are associated with a specific platform and equipment. Once designation of all variable information (net members, platforms, and equipment), specific equipment fill locations defined, keys are associated with the equipment locations. The equipment records, which include platform data, net data, and key tags, maybe downloaded to the data terminal device, and subsequently associated with the required key. Similarly, the EP data and SOI generated by the JACS workstation operator maybe downloaded to the data terminal device.

JOINT SPECTRUM INTERFERENCE RESOLUTION ONLINE

5-61. Joint spectrum interference resolution online (JSIRO) collaboration portal is the preferred tool for reporting EMI occurrences. JSIRO is a Web-based, centralized application containing data and correspondence for reported EMI, intrusion, and jamming incidents dating back to 1970. JSIRO is the repository for the results of analyses, collected data, and supporting documentation for EMI resolution to support both trend and future interference resolution analysis. To access the JSIRO tool utilize a SIPRNET link. JSC provides management and control of the JSIRO. The tool is hosted through Intelink and the joint worldwide intelligence communication system. The spectrum manager may access the tool through a SIPRNET connected computer without the need for loading software onto the computer. JSIRO allows the user to upload files that may be instrumental in mitigating the EMI; such as spectrum analyzer traces, recorded audio, or comma separated values files. Use the manual JSIR report format when SIPRNET access is not available.

5-62. When reporting online, JSIRO prompts the user for required information using a fill-in-the-blank form. Checkboxes and dropdown menus supply choices where possible. The JSIRO provides free text input space for input of directly into the report. Text from e-mail and other documents maybe copied and included into the JSIRO report or added as attachments. Submitted reports maybe updated as further information becomes available.

JOINT SPECTRUM DATA REPOSITORY

5-63. The Defense Spectrum Organization collects, standardizes, and distributes spectrum-related data. The Defense Spectrum Organization provides direct on-line data access to the joint spectrum data repository (JSDR) and provides customized reports. The JSDR contains DOD, national, and international spectrum-related information up to the secret level and can be accessed via the joint spectrum center data access web server (JDAWS) tool. JDAWS provides user access to the database components of JSDR.

5-64. The JSDR provides access to a collection of over 100 area studies. Area studies are Defense Spectrum Organization produced country-specific telecommunication profiles hosted on Intelink. Area studies found within the JDAWS provide a hyper-link access to the Intelink site.

5-65. The JSDR contains various resources in a variety of formats. The following are the primary features of the JSDR—

- **Joint Equipment, Tactical, and Space (JETS) Database:** The JETS segment of JSDR is a Defense Spectrum Organization created and maintained resource that includes: Parametric data for DOD; commercial and multinational equipment; platform data, including equipment complements; U.S. military unit names, locations and hierarchy; U.S. military unit equipment and platform complements; and space satellite parametric and orbital data.
- **Host Nation Spectrum Worldwide Database Online (HNSWDO)** is a web-based application for processing DOD Host Nation Coordination Requests and responses.

- **Spectrum Certification System (known as SCS) Database** is the central archive repository for all DOD spectrum certification system data, including information from the joint force 12 (known as the J/F-12), Application for Equipment Frequency Allocation. J/F-12 is the unique tracking number assigned by the Army Spectrum Management Office.
- **Background Environmental Information (known as BEI) Database:** To accurately represent the electromagnetic environment, the Defense Spectrum Organization collects additional non-U.S. Federal and international frequency assignments, which are stored in the BEI database. The BEI currently includes International Telecommunication Union, Federal Communications Commission, Canadian, and Radio Astronomy assignments.
- **Government Master File (known as GMF) Database:** The GMF is a data source containing records of the frequency assigned to all U.S. Federal Government agencies in the U.S. and its possessions. Data is obtained from NTIA.
- **Frequency Resource Record System (known as FRRS) Database:** FRRS contains information on DOD frequency assignments used throughout the world that is controlled by the Commanders of the Unified Commands and the Military Departments.
- **Electronic Order of Battle (known as EOB) database:** The JSDB contains nearly 25,000 Defense Intelligence Agency EOB foreign equipment locations.

Appendix A

Spectrum Management Task List

This appendix describes the current spectrum manager task list to include each task and their supporting sub-tasks. This appendix also contains flow charts that describe the collaboration process between spectrum managers and the EW Cell.

TASKS

A-1. Tasks assigned or associated with spectrum management are based on unit specificity. Spectrum management encompasses a wide range of military activities and missions. Each unit will have standard operating procedures to enable spectrum management operations.

A-2. Each unit provides the spectrum manager with a unique set of circumstances. As an example, assignments to Aviation units differ from Special Operations units in the deployment and use of SDD and related systems.

PLAN THE USE OF THE ELECTROMAGNETIC SPECTRUM FOR ALL SPECTRUM DEPENDENT DEVICES

A-3. Planning for spectrum use requires information from a variety of sources. The spectrum manager uses force structure templates to plan missions. Forces submit spectrum requirements for all devices used for the mission to the spectrum manager. The spectrum manager submits frequency proposals to appropriate agencies in the correct format (SFAF or SSRF). Frequency record creation in the appropriate database prevents other units from requesting the same spectrum resources. Supporting sub-tasks for plan the use of the electromagnetic spectrum for all spectrum dependent devices include—

- Conduct a data call.
- Generate frequency proposal.
- Process frequency proposal from subordinate units.
- Analyze spectrum resource allocations and partition them into allotment plans and assignments.
- Nominate assignments against allotments (spectrum resources).
- Create and edit a frequency record.
- Provide input to the production of Annex H (OPORD).

CONDUCT ELECTROMAGNETIC INTERFERENCE ANALYSIS

A-4. The spectrum manager conducts analysis of the spectrum's impact on the mission. Identification of EMI caused by a mission occurs during the initial planning process using SMO tools. This allows course of action (COA) development to eliminate or mitigate the interference. Spectrum users and spectrum managers identify EMI during mission execution through various ways, such as reports of degraded communications, inoperable sensors, or malfunctioning equipment. The spectrum manager analyzes the EMI to identify the cause of the EMI. EMI happens for various reasons, such as operator programming errors, or blue, grey, or red force jamming (intentional or otherwise). The primary resources that the spectrum manager has for EMI mitigation is spectrum monitoring and direction finding devices used in conjunction with the JSIR process and interagency collaboration. As outlined in the JSIR procedures, mitigate EMI at the lowest echelon possible. EMI reporting, to higher echelons, occurs for all EMI occurrences. Reporting EMI occurs regardless of a resolution for the interference.

Note. See CJCSM 3320.02D for more information on JSIR.

The following sub-tasks support the task conduct electromagnetic interference analysis—

- Identify EMI.
- Provide recommendation to eliminate and or mitigate interference.
- Prevent frequency substitution by locking nets, and assignments.
- Provide recommended frequency modification or substitution by user assigned priority.
- Import and validate JSIR input from subordinates.
- Export JSIR to higher headquarters.

Note. The JSC serves as the center for EMI mitigation and monitors the JSIRO collaboration portal. JSIRO is accessible through the SIPRNET link provided in the reference portion of CJCSM 3320.02D. JSIRO is currently the preferred method of reporting EMI occurrences.

ASSIGN FREQUENCIES WITHIN THE OPERATIONAL PARAMETERS OF SDD AND AVAILABLE RESOURCES

A-5. The use of SMO tools provides the spectrum manager with operational characteristics of all SDDs validated by the DD Form 1494 process. The spectrum manager performs analysis of the operational requirements of a mission based on the characteristics of each device. Host nation comments and agreement allows the spectrum manager to construct allocation tables for the operational area. The spectrum manager assigns frequencies based on these allocations to requesting units for use during the mission. The following sub-tasks support this task—

- Conduct data call.
- Determine if SDD is supportable in area of interest.
- Coordinate for spectrum usage with host nation.
- Create and edit a frequency record.

OBTAIN REQUESTS AND PROVIDE ELECTROMAGNETIC SPECTRUM RESOURCES TO REQUESTING UNIT

A-6. Subordinate units submit frequency requests, in the correct format (SFAF or SSRF), to the spectrum manager after a unit receives a mission and determines spectrum requirements to support that mission. The following sub-tasks support this task—

- Conduct data call.
- Determine if SDD is supportable in area of interest.
- Coordinate for spectrum usage with host nation (HNSWDO).
- Create and edit a frequency record.

PROVIDE ELECTROMAGNETIC OPERATIONAL ENVIRONMENT INFORMATION IN EITHER A NETWORKED OR STAND-ALONE MODE

A-7. Sharing of information within and between agencies is critical for accurate and efficient spectrum management. As SMO tools become more NCE compliant, sharing of critical information among agencies becomes easier. As the spectrum manager may not always have access to the network, SMO tools must remain functional in a stand-alone mode. The following sub-tasks support this task—

- Derive specific mission requirements from operational plan.
- Maintain situational awareness of the EMOE.
- Conduct EMOE information data exchange with peer-to-peer, subordinate to higher and higher to subordinate users.
- Delete, modify, and export user selected background data.
- Conduct analysis.

PERFORM MODELING AND SIMULATION OF THE EMOE VIA USER SELECTED DATA FIELDS OF THE IMPACT OF THE EMOE ON PROJECTED SPECTRUM PLANS

A-8. Modeling and simulation of the EMOE using SMO tools allow for mitigating the effects of SDD on unintended bystanders. It also allows for development of various COAs during the MDMP upon receipt of an OPORD or fragmentary order. It is critical for the spectrum manager to monitor the spectrum continually in order to detect EMI or EW during mission performance. The following sub-tasks support this task—

- Conduct data call.
- Maintain situational awareness of the EMOE.
- Derive specific mission requirements from the operation plan (OPLAN) or OPORD.
- Conduct analysis.

MONITOR AND USE SPECTRUM COMMON OPERATIONAL PICTURE INFORMATION IN SUPPORT OF UNIFIED LAND OPERATIONS

A-9. The COP provides commanders with an easy to understand picture of all relevant information that pertains to a mission. This requires an accurate and up-to-date depiction of spectrum use within the operational area. For instance, the spectrum manager uses a spectrum analyzer or monitoring receiver to identify signals in the operational area and overlay the results with a color-coded display on a two or three-dimensional picture of the area. The following sub-tasks support this task—

- Maintain situational awareness of the EMOE.
- Export the Spectrum Plan in a format compatible for import by mission command systems.
- Provide spectrum situational awareness to the common operational picture.

PRIORITIZE SPECTRUM USE BASED ON COMMANDERS GUIDANCE

A-10. When the requirement for spectrum exceeds the supply, spectrum use priority becomes established. The commander, normally with input from the G-6 or S-6 spectrum manager, institutes prioritization. Priorities placed into various SMO tools for planning missions makes prioritization very efficient. Prioritization of spectrum users allows interference mitigation in accordance with the commander's intent. The following sub-tasks support this task—

- Maintain situational awareness of the EMOE.
- Identify conflicts.
- Perform spectrum course of action analysis.

UTILIZE ELECTRONIC WARFARE REPROGRAMMING DURING THE NOMINATION, ASSIGNMENT, AND DECONFLICTION PROCESSES

A-11. Blue force electronic warfare can easily disturb other spectrum users within the EMOE. Coordination between the CEMA element spectrum manager and the G-6 or S-6 spectrum manager can mitigate many of these disturbances. SMO tools allow the spectrum manager to analyze the effects of EW and provide frequency deconfliction recommendations to return spectrum users to operational status (if possible). There are no sub-tasks associated with this task.

IMPORT SATELLITE ACCESS AUTHORIZATION

A-12. The Defense Information Systems Agency regional satellite support center responsible for the area of operations for the mission disseminates satellite access authorizations to all required agencies concerned with satellite resources, to include the brigade satellite communications noncommissioned officer. Spectrum managers import the authorizations for all satellite users within the unit and transfer it to the proper MCEB format. This allows for a more complete picture of the spectrum for all spectrum management agencies. The supporting task is modify satellite access authorization record to ensure required data fields comply with the MCEB standard for assignment.

Note. The satellite access authorization authorizes frequencies for use on satellite systems. The satellite access authorization does not provide area frequency clearance in the operational area. Spectrum managers must obtain frequency clearance from the host nation using guidelines for the respective geographic commander prior to allowing units to transmit on the assigned uplink frequency. Deconflict these frequencies from other ground-based emitters to prevent interference during mission execution.

GENERATE AND DISTRIBUTE SOI AND JCEOI

A-13. The SOI and JCEOI provide the Army and joint units with detailed regulations concerning spectrum use for the duration of a mission. The spectrum manager must use SMO tools with SOI or JCEOI generation and distribution capabilities to provide units with this regulation. The following sub-tasks support this task—

- Conduct data call.
- Build and test base SOI or JCEOI.

CREATE, IMPORT, EXPORT, EDIT, DELETE, DISPLAY, AND DISTRIBUTE THE JOINT RESTRICTED FREQUENCY LIST

A-14. The JRFL is a management tool used by various operational, intelligence, and support elements to identify the level of protection desired for a critical function utilized within the electromagnetic spectrum. EW planners utilize the JRFL to conduct mission planning and to mitigate the effects of friendly offensive and defense electronic attack when possible. The JRFL does not provide protection from other spectrum users. Planners limit JRFL entries to the minimum number of radio frequencies and intelligence equities necessary for friendly forces to accomplish mission objectives. The JRFL entry contains at a minimum—

- Tactical/operational point of contact for frequency usage.
- Center channel of the frequency assignment.
- Emission designator.
- Name of receiver location.
- Geolocation of receiver.
- Protection radius of receiver.
- Justification for protection.
- JRFL code (protected, taboo, guarded).
- Serial number of Spectrum XXI frequency record for transmitters only. Receivers or sensors do not have a record.

A-15. The spectrum manager receives requests from subordinate units to place friendly force spectrum users into the JRFL. Spectrum managers validate organizational and subordinate JRFL requests and forward them to higher echelons for approval. The command with responsibility for developing and promulgating the JRFL validates subordinate unit input. Upon completion of the JRFL, the spectrum manager disseminates the JRFL to subordinate users. This task is supported by the following sub-tasks—

- Gather and compile JRFL input.
- Validate JRFL input (codes: taboo, guarded, and protected).
- Export JRFL input to higher headquarters.
- Import completed JRFL from higher headquarters.
- Export completed JRFL to subordinates.

ACCESS AND USE SPECTRUM OPERATIONS TECHNICAL DATA

A-16. Every SDD has operational characteristics that allow it to perform the intended functions. The spectrum manager accesses these characteristics through various spectrum databases and uses them during the frequency assignment process to ensure that spectrum resources support the proper operation of the device. Some of these characteristics include waveforms, number of frequencies used, transmit and receive power, and frequency bands. The following sub-tasks support this task—

- Delete, modify, and export user selected background data.
- Determine if spectrum dependent device is supportable in the operational area.

MANAGE, STORE, AND ARCHIVE SPECTRUM USE DATA (FREQUENCY MANAGEMENT WORK HISTORY) AND UTILIZE HOST NATION COMMENTS IN THE SPECTRUM NOMINATION AND ASSIGNMENT PROCESS

A-17. The spectrum manager uses SMO tools to file spectrum use data and utilize host nation comments during the spectrum nomination and assignment process. This process not only aids current mission planning but also planning for future missions. The following sub-tasks support this task —

- File data according to regulatory records.
- Coordinate for spectrum usage with host nation (HNSWDO).

SUB-TASK LIST

A-18. The following list provides a description of the sub-tasks as they pertain to the functions of the Army spectrum manager—

- **Conduct Data Call:** The spectrum requirements data call message provides guidance to staff elements, components, and supporting agencies on how to request spectrum support for SDD systems that operate under their control within the area of operations. This multipart message should cover the following subjects—
 - Spectrum management policy and guidance.
 - Security classification guidance.
 - Frequency and communications-electronic operating instructions.
 - Master net list request procedures.
 - Guidance for identifying nets and frequencies to be included on the JRFL.

Note. For a sample of the data call format, see CJCSM 3320.01C, Annex A, appendix A, enclosure C.

- **Process frequency proposals from subordinate units:** The spectrum manager receives frequency requests from subordinate units in the format described in the data call message. This allows the spectrum manager to place the required information into the planning software and analyze the impact of the request on the spectrum. Also of concern is receipt of agency approval, host nation supportability operations using host nation comments, receiving and updating spectrum related databases, and input from the area frequency coordinator. Once the spectrum requirements exist within databases, the spectrum manager determines spectrum supportability of the request.
- **Generate frequency proposal:** Once the frequency proposal processing is complete, the spectrum manager submits the proposal in the correct format (SFAF or SSRF) to obtain frequency assignment. Use of SMO tools allows the manager to accurately generate and submit frequency proposals to the appropriate agencies.
- **Analyze spectrum resource allocations and partition them into allotment plans and assignments:** spectrum managers receive a range of frequency allocations in a given area for SDD. The spectrum manager can use SMO tools to analyze force spectrum requirements and submit frequency proposals based on the analysis.
- **Nominate assignments against allotments (spectrum resources):** If provided allotments for use within given bands of the spectrum, the spectrum manager assigns frequencies to spectrum users. The SMO tool in use during the planning process, determines possible frequency assignments and if they are supportable.
- **Create and edit a frequency record:** A frequency record includes all information pertaining to spectrum use of a specific unit or force (blue, red, or grey). Frequency records include characteristics, capabilities, frequency proposal and assignment, frequency clearance, and the

force structure supporting the frequency use. Frequency records consolidation occurs during the normal procedures for obtaining frequency assignment with SMO tools. Location of the frequency records are in various databases.

- **Provide input to the production of Annex H (OPORD):** Annex H of the OPORD concerns signals. The spectrum manager places key spectrum information in Annex H of the OPORD. This allows the commander and subordinate units to have a clear picture of the operational environment.
- **Identify EMI:** EMI can present itself in various ways. For instance, a communications terminal may contact the brigade or battalion headquarters concerning difficulty receiving a signal from another communications terminal. The primary tool used to identify immediate EMI is S2AS. The S2AS can scan the specific frequency range that the terminal is operating within for jamming, intermodulation, and noise, and eventually locate (through direction finding) and assist the spectrum manager in determining the cause of the EMI (frequency fratricide or enemy EW).
- **Provide recommendation to eliminate and or mitigate interference:** The SMO tools in use can perform mitigation or frequency deconfliction of EMI occurrences. Recommendations provided to the commander from the spectrum manager enhance decision-making. The commander may decide to continue with limited spectrum use or obtain frequency reassignment.
- **Prevent frequency substitution by locking nets and assignments:** Based on mission priority and commander's discretion, the JRFLE lists frequencies and networks that require protection from friendly force spectrum users. A variety of SMO tools allow for automatically locking nets and assignments during the mission planning process.
- **Provide recommended frequency modification or substitution by user:** Frequency modification or substitution occurs to obtain new frequencies for users that experience unresolved EMI. The commander may deem frequency modification necessary based on user priority during EW operations.
- **Conduct analysis:** The spectrum manager conducts analysis when using SMO tools to plan spectrum use. Tools determine the impact of spectrum use in the operational area by calculated EMI, spectrum requirements, and force structure. The analysis results determine if the spectrum can support a given COA.
- **Export Spectrum Plan in a format compatible for import by mission command systems:** The SMO tools currently in use are capable of exporting the correct format for use by various command systems. The spectrum manager verifies accuracy and completeness of the spectrum plan prior to exporting it in the correct format to various mission command systems.
- **Provide spectrum situational awareness to the COP:** This occurs during mission performance by using spectrum analyzers or receivers. The spectrum manager can use these tools while stationary to detect unknown or unplanned signals. Mobile packages or antennas allow for direction finding and locating these signals to determine spectrum COA analysis.
- **Identify conflicts:** Spectrum awareness identifies when spectrum conflicts occur. These conflicts may be blue, grey, or red forces. Use the JSIR procedures and spectrum awareness tools to locate, characterize, and determine critical information concerning the signal(s) in question.
- **Perform spectrum COA analysis:** Differing SMO tools develop COAs during the planning phase of a mission. This allows the commander to choose the best COA. During mission execution, EMI occurrence requires the development of COAs. The nature of the EMI (blue, red or grey force caused EMI) determines the development of COAs. The spectrum manager may possibly require new frequencies for users. Another COA, based on the impact of the EMI and mission priority, may be simply to do nothing. The JSIR procedures include directions and reporting procedures to mitigate EMI.
- **Modify Satellite Access Authorization records to ensure required data fields comply with the MCEB standard for assignment:** Spectrum users that depend on satellite resources require a satellite access authorization from the regional satellite communications support center responsible for the location of the user. The regional satellite communications support center disseminates satellite

access authorizations to the brigade satellite communications operations noncommissioned officer that requested the satellite resources. The spectrum manager must receive the authorization and transfers the information into the correct SFAF or SSRF (MCEB Publication 7 or 8) format prior to obtaining frequency clearance in the area. SMO tools automatically complete this process after importing the authorization.

Note. The regional satellite communications support center generally interfaces with brigade satellite operations. In some cases, the brigade spectrum manager is also the satellite operations NCO.

- **Import and validate JSIR:** Report EMI at the lowest level recognized. The spectrum manager attempts to mitigate the EMI at the lowest level possible using the JSIR procedures (CJCSM 3320.02D). If that level cannot rectify the situation, it escalates to the next higher level until EMI resolution. Spectrum users and managers of all levels report EMI occurrences to the next higher echelon, regardless of severity or cause. SMO tools allow the spectrum manager to import a JSIR report and determine the validity of the information. If SIPRNET access is available, use the JSIRO collaboration portal for EMI reporting.
- **Export JSIR to higher headquarters:** Once imported and validated the next higher headquarters takes action. If SIPRNET access is available, use the JSIRO collaboration portal for EMI reporting. If not, various SMO tools allow for exporting the JSIR to higher headquarters.
- **Derive specific mission requirements from OPLAN or OPORD:** The OPLAN or OPORD contains a variety of information that spectrum managers may use to perform key tasks, such as generating the SOI or performing a data call.
- **Maintain Spectrum Analysis of the EMOE:** This task is an ongoing task for the duration of a mission. Ideally, the spectrum manager performs live spectrum analysis even before the mission becomes active to determine whether the planned frequencies have interference. Once active, live spectrum monitoring plays a critical role in identifying, analyzing, and mitigating EMI.
- **Conduct EMOE information data exchange with peer-to-peer, subordinate to higher and higher to subordinate users:** Spectrum managers update a variety of databases, especially in a joint environment, to remain effective in spectrum use. SMO tools currently in use allow for easy data exchange through common formats and central databases.
- **Delete, modify, and export user selected background data:** User selected background data involves obtaining detailed SDD data and characteristics. Background data characteristics are located in spectrum related databases. The spectrum manager must update the selected background data periodically to ensure that the databases reflect accurate information.
- **Build and test base SOI or JCEOI:** The spectrum manager uses SMO tools to develop the SOI or JCEOI based on mission requirements and commander's intent. The SOI or JCEOI gives the spectrum user guidelines for operating within the spectrum and instructions for reporting spectrum issues.
- **Determine if spectrum dependent device is supportable:** Completion of the DD Form 1494 is critical in determining the area of interest supportability. Also of use are the various spectrum databases, such as Spectrum XXI, CJSMPT's spectrum knowledge repository, and HNSWDO.

Note. The user of the SDD is responsible for DD Form 1494 processing and completion.

- **File data in accordance with regulatory records:** Data compliance with SFAF or SSRF, Federal Communications Commission, NTIA, International Telecommunications Union, and host nation formatting to file

data correctly. Use of various SMO tools automates the process of formatting during the frequency acquisition process.

- **Gather and compile JRFL****Error! Bookmark not defined. input:** Depending on mission priority and commander's discretion, some (but not all) spectrum users may be on the JRFL protected list.
- **Validate JRFL input (codes: taboo, guarded, and protected):** Many users request placement on the JRFL. However, JRFL code selection requires validation of mission priority and commander's discretion.
- **Export JRFL input to higher headquarters:** Once the JRFL validation is complete, the spectrum manager exports it to higher headquarters to place the user's SDD on the central JRFL. SMO tools allow the user to export JRFL information in the correct format.
- **Import completed JRFL from higher headquarters:** The higher headquarters completes and compiles the JRFL based on subordinate unit's inputs. The spectrum manager then imports the JRFL from the higher echelon and prepares to disseminate it to subordinate units.
- **Export completed JRFL to subordinates:** The spectrum manager disseminates the approved JRFL to subordinate units to place the JRFL into effect. Various SMO tools allow for the easy distribution of the completed JRFL.
- **Coordinate for spectrum usage with host nation (HNSWDO):** When operating outside the U.S. and its possessions, it is critical to coordinate spectrum use within the area of operations with the host nations. Use of the spectrum within a host nation without authorization from that nation causes international consequences, such as fines, imprisonment, or loss of life. HNSWDO is the primary means for the spectrum manager to determine host nation spectrum supportability for SDD.
- **Perform person-to-person host nation coordination:** When delegated under combatant command authority the Joint Task Force J6 JSME may be required to conduct host nation coordination in support of Joint Task Force spectrum access within the joint operational area.
- **Distribute JRFL electronically or by printed text:** The spectrum manager disseminates the completed JRFL to the units that require it. SMO tools currently in use allow for easily disseminating the JRFL to required agencies electronically or by printed text.

SMO TO EW FLOW CHARTS

A-19. The following flow charts describe the collaboration process between the G-6 or S-6 spectrum manager and the EW Cell. Figure A-1 shows an overview of the entire process. Descriptions of tasks shown in these figures that relate to spectrum manager are located beneath the chart. For more information concerning EW Cell tasks, review ATP 3-36 and JP 3-13.1.

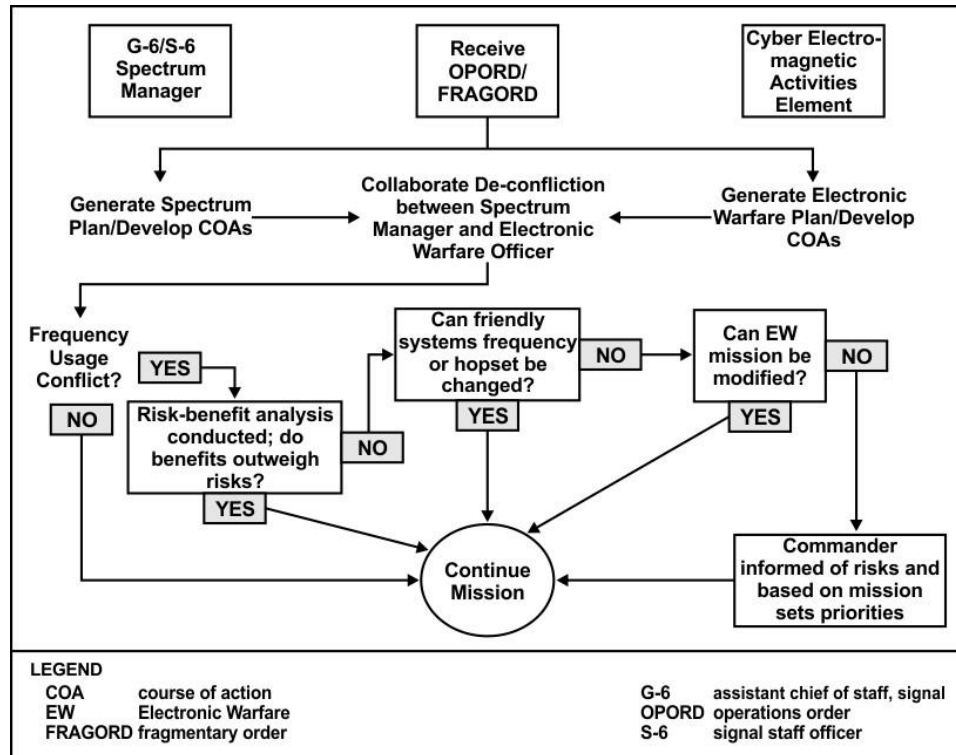


Figure A-1. The SMO to EW collaboration process

A-20. Figure A-2 shows a detailed description of the SMO tasks that support the collaboration process.

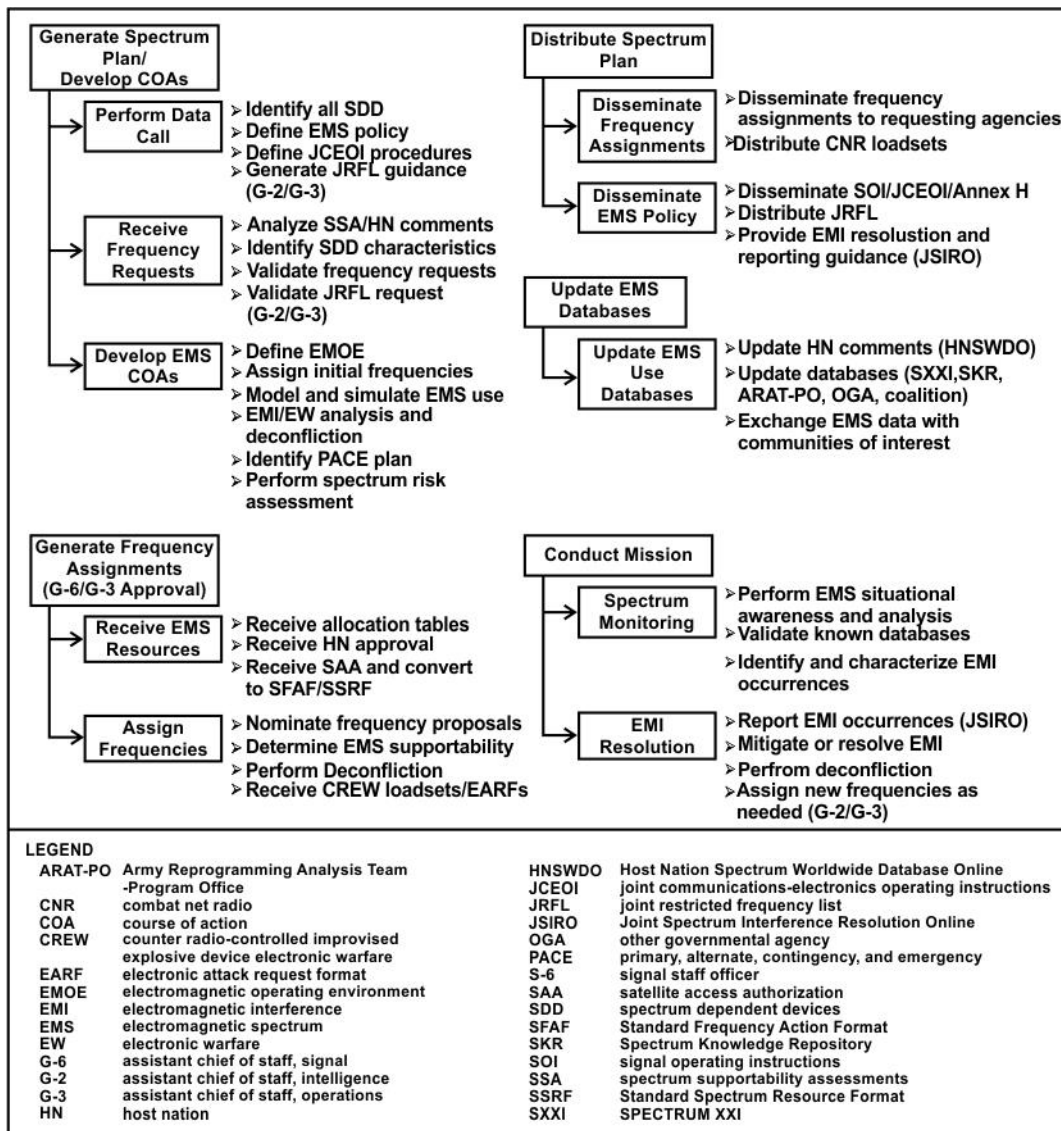


Figure A-2. The G-6 or S-6 spectrum manager's tasks

A-21. **Generate Tactical Spectrum Plan and Develop COAs:** The spectrum managers use various SMO tools to plan a mission (CJSMPT, Spectrum XXI, and SPEED). The spectrum manager generates a data call message to all subordinate units. The data call message directs the units to—

- Identify all SDD.
- Define spectrum policy.
- Defines the procedures included on the JCEOI, and defines JRFL Guidance.

A-22. **Receive Frequency Request:** As the units answer the message, the spectrum manager receives frequency requests in accordance with mandatory formats (SFAF, SSRF, NTIA or International Telecommunications Union required items). Spectrum managers review the spectrum dependent device characteristics and determine if each has passed the spectrum certification process (DD Form 1494), and is supportable in the operational area by reviewing host nation comments (HNSWDO). The spectrum manager validates frequency requests by checking for inflated requests (such as the unit requests more frequency than needed). The spectrum manager validates JRFL requests with the G-2 and G-3; this ensures warranted

protection requests. The spectrum manager also prioritizes spectrum users, with the G-3, to aid in planning and prioritizing frequency requests.

A-23. **Develop COA:** Spectrum managers develop COAs for the mission and issue initial frequency assignments to perform modeling and simulation for the spectrum. Various SMO tools identify EMI caused by various sources and provide deconfliction recommendations. Spectrum managers also perform a spectrum risk assessment to determine the effects of the SDD in the area of responsibility. The commander may choose the COA according to all of the identified spectrum issues and risks.

A-24. **Generate frequency assignments:** The spectrum manager receives spectrum resources, in the form of allocation tables and permissions, from higher echelon (such as Army Spectrum Management Office, JFMO, and host nation coordination). The spectrum manager uses SMO tools to transfer the information into SFAF or SSRF format and place it into spectrum use databases.

A-25. Spectrum managers assign frequency and nominate frequency proposals to the approving authority using SMO tools. Upon receiving approved frequency assignments, the spectrum manager determines spectrum supportability of any new or revised frequencies. Spectrum managers receive counter radio-controlled improvised explosive device EW loadsets and electronic attack request format frequencies from the EW Cell. The spectrum manager performs deconfliction to mitigate EMI caused by EW efforts.

A-26. **Distribute Tactical Spectrum Plan:** The spectrum manager disseminates the plan to all required agencies (JFMO, JSME, and CEMA element) and provides spectrum data to communities of interest such as unified action partners. The spectrum manager generates and distributes combat network radio loadsets. The spectrum manager disseminates approved policies for spectrum use, to include the SOI or JCEOI Annex H (OPORD), the completed JRFL, and EMI resolution guidance (CJCSM 3320.02D).

A-27. **Update Spectrum Databases:** The spectrum manager updates various spectrum related databases HNSWDO, Spectrum XXI.

A-28. **Conduct Mission:** Spectrum managers conduct spectrum monitoring prior to conducting the mission to validate spectrum databases and identify differences between planned authorized frequencies and spurious or unauthorized frequencies in use. Spectrum managers use spectrum analyzers and spectrum analysis software to monitor frequencies. Spurious and unauthorized frequencies may be found through direction finding and triangulation. Spectrum monitoring during the mission identifies and characterizes EMI occurrences. Upon EMI occurrence, the spectrum manager performs EMI resolution mitigation and reporting procedures. The spectrum manager uses the characterized data to submit a JSIR report. The spectrum manager then follows the steps in the CJCSM 3320.02D, to attempt to resolve and mitigate the EMI at the lowest echelon possible. If resolution is not possible, the spectrum manager provides spectrum users with new frequency assignments.

A-29. Figure A-3 provides a graphic depiction of EW Cell tasks that support the SMO collaboration process.

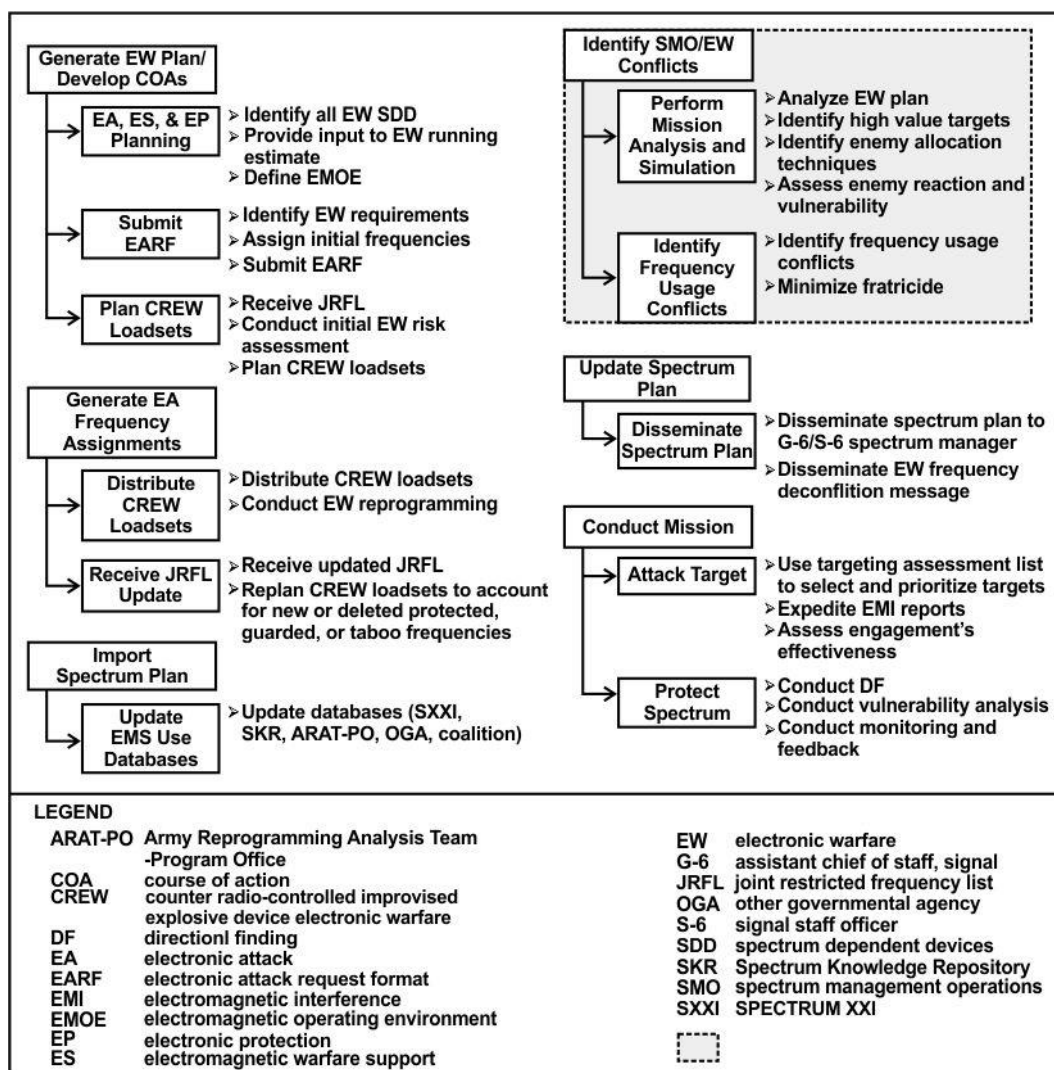


Figure A-3. The CEMA element tasks

A-30. The CEMA element, with guidance from the S-6, G-6, G-2, and G-3, generates the EW Plan that includes EA, electronic warfare support, and EP planning. This plan results in development of the electronic attack request format and includes spectrum use requirements. The CEMA element plans counter radio-controlled improvised explosive device EW loadsets.

A-31. The CEMA element plans and distributes counter radio-controlled improvised explosive device EW loadsets to required users. The JRFL, once imported, aids in planning counter radio-controlled improvised explosive device EW loadsets.

A-32. The CEMA element receives the tactical spectrum plan from the G-6 and S-6 spectrum manager. The CEMA element also uses the tactical spectrum plan and SMO tools to identify conflicts caused by the EW plan.

A-33. The CEMA element, upon determining that the EW plan causes no conflicts, updates the tactical spectrum plan and disseminates it to the G-6 and S-6 spectrum manager. This allows the G-6 and S-6 spectrum manager to update spectrum databases and prevent frequency assignments that conflict with the EW Plan. Battalion and brigade staff elements receive the EW plan and approve the validated plan. Upon approval, put the EW plan into action.

A-34. Figure A-4 shows the collaboration between the spectrum manager, the G-6, and the G-3.

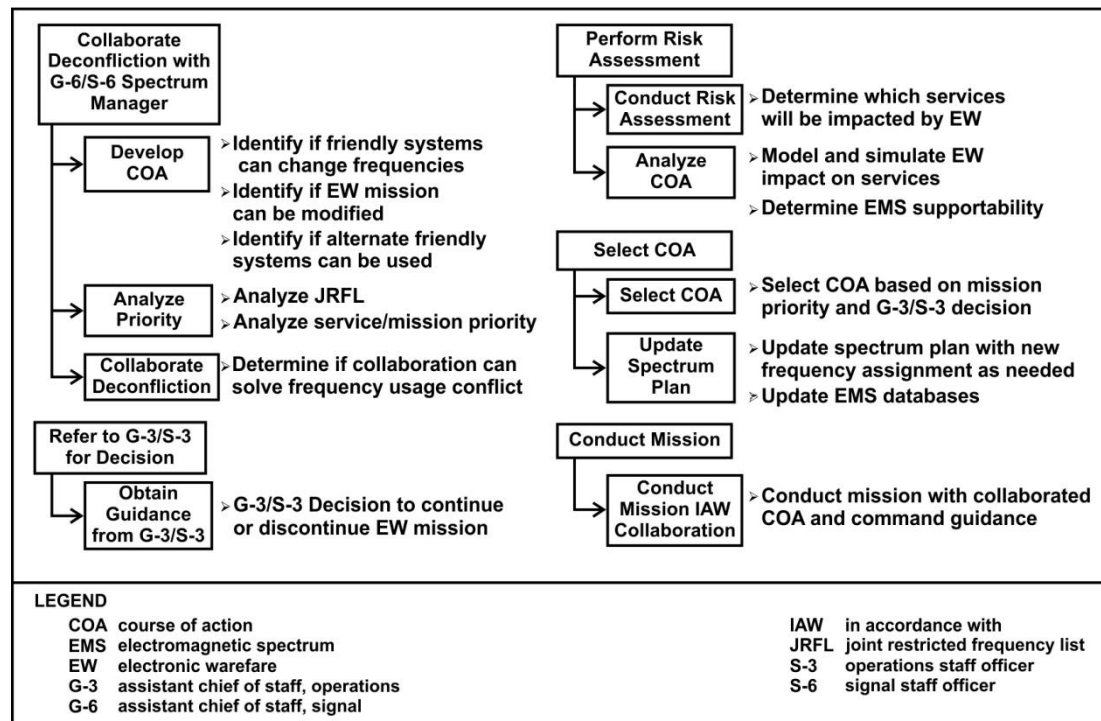


Figure A-4. SMO collaboration tasks

A-35. Collaboration and deconfliction with spectrum manager occurs when the CEMA element identifies frequency conflicts. The collaboration determines if friendly systems can change frequencies, if not, consider possible modification of EW mission, determine if friendly forces can use a different system. If these steps resolve the conflict, continue to conduct the mission. The G-3 determines which services or missions to end or alter. Services or mission termination are done by priority of the EW mission or the service. Based on G-3 guidance, the spectrum manager performs an assessment on the new, altered mission. Determine the spectrum supportability for the mission. Develop COAs for the mission change. With direction from the G-3, select and enact the appropriate COA. Refer to G-6 or S-6 spectrum manager and CEMA element to conduct mission blocks.

A-36. Upon mission completion, each agency conducts after mission actions. These include submitting frequency assignments for deletion, updating spectrum databases, and updating host nation comments to aid in future mission planning.

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Appendix B

Capabilities and Compatibility between Tools

This appendix provides an overview of the capabilities and compatibilities of various SMO tools. There are many tools spectrum managers use to perform their duties. Due to the many tools available, compatibility understanding is of great importance.

CAPABILITIES AND COMPATIBILITY

B-1. The spectrum manager should have an understanding of SMO tool capabilities and compatibility in order to complete required tasks. Table B-1 shows the current compatibilities among tools with a description of known compatibility fixes. Table B-2 on page B-2 shows the capabilities by tool with a description of each capability.

Table B-1. Compatibility between SMO tools

TOOL	<i>Spectrum XXI</i>	<i>Spectrum XXIO</i>	<i>CJSMPT</i>	<i>S2AS</i>	<i>AESOP</i>	<i>SPEED</i>	<i>ACES/JACS</i>	<i>HNSWDO</i>
Spectrum XXI		*	X	X	X	X	X	
Spectrum XXIO	*		X	X	X	X	X	X
CJSMPT	X	X		X		X	X	X
S2AS	X	X	X					
AESOP	X	X						X
SPEED	X	X	X					X
ACES/JACS	X	X	X					X
HNSWDO		X	X		X	X	X	
Legend: X = formatting compatible * = limited format compatibility blank = not currently compatible ACES automated communications engineering software AESOP Afloat Electromagnetic Spectrum Operations Program CJSMPT Coalition Joint Spectrum Management Planning Tool HNSWDO Host Nation Spectrum Worldwide Database Online JACS joint automated communications-electronics operation instructions system S2AS Spectrum Situational Awareness System SPEED systems planning, engineering, and evaluation device								

COMPATIBILITY BETWEEN SMO TOOLS

B-2. For the purpose of this ATP, SMO tools have format compatibility if they can import and export spectrum related files from other SMO tools without the need to modify the format. Format compatibility between tools complies with the NCE concept and reduces time constraints for spectrum manager in a joint environment. Limited format compatibility means that the tool has the capability of importing or exporting spectrum related files between another tool but requires the spectrum manager to manipulate format inconsistencies. For instance, legacy Spectrum XXI records modify or delete records in Spectrum XXI Online, but cannot create new records.

B-3. Table B-2, on page B-2, compares SMO tool and shows the capability of each tool. A description of each capability follows the table.

Table B-2. SMO tool capabilities

<i>SMO Capability</i>	<i>SMO Tools</i>							
	<i>Spectrum XXI</i>	<i>Spectrum XXIO</i>	<i>CJSMPT</i>	<i>HNSWDO</i>	<i>S2AS</i>	<i>AESOP</i>	<i>SPEED</i>	<i>ACES/JACS</i>
Spectrum measurement and direction finding					X			
Live Spectrum Analysis					X			
EW/EMI analysis and frequency deconfliction (fixed location)	*	X	X			X	X	
EW/EMI analysis and frequency deconfliction (on-the -move)		X	X			X	X	
2D/3D Simulation and Modeling of EMOE	*	X	X		X	*	X	
Plan spectrum reuse and minimize requirements			*				*	X
Import satellite access authorization and convert to SFAF/SSRF			X				X	
“Drag and Drop” Force structure templates		*	X			X	X	
Assign Frequencies	X	X	*			*	*	*
Access JETS database		X	X					
Access 2D/3D Digital Terrain databases	*	X	X		X	X	X	
Access CREW loadsets			X			X		
Access HN comments				X				
XML Format		X	X		X	X	X	
HTML Format			X		X			
CSV Format			X		X		X	
Generate SOI/JCEOI						X		X
Provide input to SOI/JCEOI			X					
Generate JSIR report	X	X	X					
Provide JRFL input to higher echelon	X	X	X			X	X	
SFAF Format	X	*	X		X	X	X	X
SSRF Format		X	*			X	X	
Provide input to COP							X	
COA Development			X			X	*	
NCE Compliant	X	X	X			*	*	
Standalone operations	X		X	X	X	X	X	X
Legend: X = formatting compatible * = limited format compatibility blank = not currently compatible								
SMO - spectrum management operations ACES - automated communications engineering software AESOP - Afloat Electromagnetic Spectrum Operations Program CJSMPT - Coalition Joint Spectrum Management Planning Tool COA - course of action COP - common operational picture CSV - comma separated values EMI - electromagnetic interference EMOE - electromagnetic operational environment	EW - electronic warfare HN - host nation HNSWDO - Host Nation Spectrum Worldwide Database Online HTML - hypertext markup language JACS - joint automated communications-electronics operation instructions system JCEOI - joint communications-electronics operating instructions JRFL - joint restricted frequency list JSIR - joint spectrum interference resolution NCE - network-centric environment				S2AS - Spectrum Situational Awareness System SFAF - standard frequency action format SOI - signal operating instructions SPEED - systems planning, engineering, and evaluation device SSRF - standard spectrum resource format XML - extensible markup language			

SMO TOOL CAPABILITIES

B-4. SMO tool capabilities are the attributes of a system or tool utilized to perform spectrum management operations. The following list is not all inclusive and many of the SMO tools are constantly updated.

- **Spectrum measurement and direction finding:** This tool takes measurements (live) of the spectrum and provides direction finding of unknown, unplanned, EW, or EMI signals.
- **Live spectrum analysis:** This tool receives spectrum measurements and provides analysis of the measured signals over time for the purpose of frequency records, trend analysis, and EW interference detection.
- **EW and EMI analysis and frequency deconfliction (fixed location):** This tool analyses EW and EMI effects (actual or planned) on spectrum use and provides recommendations and COAs for deconfliction of the EW and EMI for stationary SDD. This also includes the analysis of second or third order harmonics, intermodulation and electromagnetic environmental effects in the areas impacted by spectrum use.
- **EW and EMI analysis and frequency deconfliction (on-the-move):** Same as above, with the exception that the tool analyzes and deconflicts SDDs while conducting communications on-the-move.
- **Two or three-dimensional simulation and modeling of EMOE:** This tool provides both a two and three-dimensional model of the EMOE to include topography, electromagnetic environmental effects, and color-coded spectrum footprints.
- **Plan spectrum reuse and minimize requirements:** This tool minimizes the impact of a mission on the spectrum through the reuse of frequencies in different locations and planning for the minimum requirements for spectrum users and provides for more flexible and available spectrum resources for all users.
- **Import Satellite Access Authorization and convert to SFAF or SSRF:** This tool imports an authorization and automatically converts it to the SFAF or SSRF approved format. This capability provides a more complete spectrum database and aids in the mitigation of EMI caused by or affecting space based SDD.
- **Force structure templates:** This tool has the capability of creating or accessing force structures and placing them quickly and easily on the three-dimensional map of the battlefield using drag and drop, with associated SDD and the general spectrum requirements for those devices.
- **Assign frequencies:** The tool can assign frequencies to users that have submitted a frequency proposal in the correct format (SFAF or SSRF). A check mark means that the tool is capable and authorized to assign frequencies. An asterisk means that the tool may assign and plan for projected frequencies approved by another tool prior to use of the projected frequency.
- **Access joint spectrum center equipment, tactical, and space (JETS) database:** This tool may query the JETS database for information and receive updates (refreshes) from the database.
- **Access three-dimensional Digital Terrain databases:** This tool imports detailed three-dimensional digital terrain data from a variety of sources, such as the terrain integrated rough earth model, or Google Maps for the purpose of planning, managing, and visualizing the EMOE. If marked with an asterisk, the tool has limited capabilities, such as two-dimensional maps only.
- **Access counter radio-controlled improvised explosive device EW loadsets:** This tool can access counter radio-controlled improvised explosive device EW loadsets for frequency deconfliction planning.
- **Access Host Nation comments:** This tool has access to host nation allocation tables that aid in planning spectrum use in various host nation locations. If marked with an asterisk, the tool has limited access, such as relying on importing data from another tool.
- **XML Format-Extensible Markup Language (XML)** is a file format that is rapidly becoming the standard for compatibility between software packages. If selected, the tool may import or export various files (records, reports, and data) in XML format.
- **HTML Format:** Hypertext Markup Language (HTML) is the main markup language for creating web pages and other information displayed in a web browser. HTML elements form the building blocks of all websites. HTML allows embedding images and objects within web pages to create

interactive forms. It provides a means to create structured documents by denoting structural semantics for text such as headings, paragraphs, lists, links, quotes and other items.

- **Comma-separated values (CSV) Format:** CSV is a common, relatively simple file format that is widely supported by consumer, business, and scientific applications. Among its most common uses is moving tabular data between programs that natively operate on incompatible (often proprietary or undocumented) formats. This works because so many programs support some variation of CSV at least as an alternative import or export format. If checked, the tool can import or export various files in CSV format.
- **Generate SOI or JCEOI:** SOI or JCEOI provide for policies and regulations to subordinate units. If selected, the tool may generate and disseminate SOI or JCEOI in the correct format to subordinate units.
- **Provide input to SOI or JCEOI:** This tool provides input to the SOI or JCEOI in compatible formats, but cannot generate the SOI or JCEOI.
- **Generate JSIR report:** Use the JSIR report format to report EMI occurrence to the next higher echelon in a joint task force operating environment. This tool has the capability of generating the JSIR report in the correct format and exporting the report to the next higher echelon.
- **Provide JRFL input to higher echelon:** The JRFL is a time and geographically oriented listing of functions, nets, and frequencies requiring protection from friendly EW. This tool allows the operator to process JRFL input from subordinate forces, provide the input to higher echelons in the correct format, and distribute the JRFL to concerned units upon approval from higher echelon.
- **SFAF Format:** This tool can propose, assign, modify, renew, review, and delete radio frequencies in the SFAF (MCEB Pub 7) approved format. If marked with an asterisk, the tool has limited capabilities, such as it can only import and read a SFAF frequency record.
- **SSRF Format:** This tool can propose, assign, modify, renew, review, and delete radio frequencies in the SSRF (MCEB Pub 8) approved format. If marked with an asterisk, the tool has limited capabilities, such as the tool requires manual workarounds to generate proposals in the SSRF approved format.
- **Provide input to COP:** The COP is a single identical display of relevant information shared by more than one command. This tool can interface and provide relevant spectrum information to the COP.
- **COA Development:** This tool can analyze spectrum resources impacted by a mission and develop many COAs to determine how to best support the mission and mitigate spectrum conflicts.
- **NCE Compliant:** This tool is compliant with the NCE concept by providing central locations for access of information (through SIPRNET or NIPRNET) to authorized users both within an agency (vertically) and between agencies (horizontally) in joint environments. If marked with an asterisk, the tool is only partially NCE compliant, such as not providing information between agencies.
- **Operate in standalone environment:** This tool can operate while disconnected from outside agencies or central databases.

Appendix C

Spectrum Physics

This appendix describes the physics of radio frequency (RF) spectrum. A basic understanding of the underlying principles of RF energy is necessary to the execution of spectrum management operations.

RADIO FREQUENCY

C-1. RF communications, based on the laws of physics, describes the behavior of electromagnetic energy waves. RF communication works by creating electromagnetic waves at a source and being able to receive those electromagnetic waves at a particular destination. These electromagnetic waves travel through the air at the speed of light. The wavelength of an electromagnetic signal is inversely proportional to the frequency; the higher the frequency, the shorter the wavelength.

C-2. Frequency measurements are in Hz (cycles per second) and radio frequency measurements are in kHz (thousands of cycles per second), MHz (or millions of cycles per second) and GHz (or billions of cycles per second). The wavelength for a device utilizing a frequency in the MHz range is longer than frequency in a GHz range. In general, signals with longer wavelengths travel a greater distance and penetrate through, and around objects better than signals with shorter wavelengths.

C-3. Waveforms are patterns of electrical energy over time. A Sine wave is the fundamental building block of electricity and other energies. A Sine wave mathematically defines a natural action describing a harmonic alternating event.

C-4. Figure C-1 provides a graphic depiction of a simple waveform. Displacement is the crest (high point) and trough (low point) of a wave. The wavelength is the distance from one crest to another or trough to another. Amplitude is the height of a crest or trough.

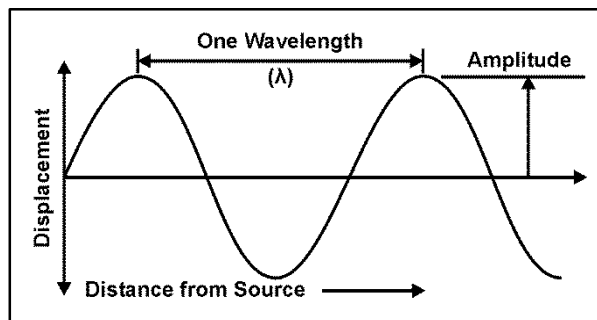


Figure C-1. Waveform characteristics

HARMONICS AND INTERMODULATION PRODUCTS

C-5. Frequencies are associated with different standing wave patterns that produce wave patterns known as harmonics. Figure C-2 on page C-2, displays the relationship between the wave that produces the pattern and the length of the medium in which the pattern is displayed. The pattern for the first harmonic reveals a half wavelength where each point on the line represents nodes and the arching middle represents antinodes. The second harmonic displays a complete wavelength; this pattern described as starting at the rest position, rising upward to a peak displacement, returning down to a rest position, then descending to a peak downward displacement and finally returning back to the rest position.

C-6. One complete wave in a standing wave pattern consists of two *loops*. Thus, one loop is equivalent to one-half of a wavelength. The third harmonic pattern consists of three anti-nodes. Thus, there are three loops

within the length of the wave. Since each loop is equivalent to one-half a wavelength, the length of the wave is equal to three-halves of a wavelength. The table has a pattern when inspecting standing wave patterns and the length-wavelength relationships for the first three harmonics. The number of antinodes in the pattern is equal to the **harmonic number** of that pattern. The first harmonic has one antinode; the second harmonic has two antinodes; and the third harmonic has three antinodes. The mathematical relationship simply emerges from the pattern and the understanding that each loop in the pattern is equivalent to one-half of a wavelength. The general equation that describes this length-wavelength relationship for any harmonic is on the right side column of Figure C-2.



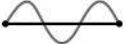


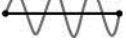
Harmonic	# of Nodes	# of Antinodes	Pattern	Length-Wavelength(λ) Relationship
1st	2	1		$L = 1 / 2 \cdot \lambda$
2nd	3	2		$L = 2 / 2 \cdot \lambda$
3rd	4	3		$L = 3 / 2 \cdot \lambda$
4th	5	4		$L = 4 / 2 \cdot \lambda$
5th	6	5		$L = 5 / 2 \cdot \lambda$
6th	7	6		$L = 6 / 2 \cdot \lambda$

Figure C-2. Wavelength relationship

C-7. Harmonics develop into currents and voltages with frequencies that are multiples of the fundamental frequency. Harmonic signals that fall within the pass band of a nearby receiver and the signal level are of sufficient amplitude can degrade the performance of the receiver. Receivers live under constant bombardment of signals which enter through the antenna port. Some of these signals quickly attenuate due to front-end filtering, which is often referred to as pre-selection.

C-8. Intermodulation generation occurs when multiple signals reach a non-linear element such as a detector, mixer, or amplifier and are mixed. Whenever signals are mixed, two additional signals are introduced as the sum and difference of the original frequencies. This process is often intentional as in the case of mixing a frequency with the intermediate frequency in a system to produce the desired operating signal. Harmonics of the original two frequencies are still present but most occur well outside the pass band of the RF and intermediate frequency filters and cause no problems. The harmonics that tend to cause the most problems are the odd-order products. For example, if a 50 MHz mixing frequency is combined with a 98 MHz intermediate frequency to produce a desired transmission signal of 148 MHz, this is very close to the 3rd order harmonic of 50 MHz (150 MHz) and may cause interference at the desired frequency. Channelized communications systems tend to suffer more from these issues due to the uniform spacing of the channels.

TRANSMISSION, PROPAGATION AND RECEPTION

C-9. A radio transmits a signal by driving a current on an antenna where the current amplitude is the changing quantity of the signal. This changing current, in turn, induces an electromagnetic field about itself, with a field strength that corresponds to the current amplitude. This electromagnetic field propagates away from the antenna as a wave at the speed of light. As the signal propagates, it attenuates. At a distant receiver, the electromagnetic wave passes across the receiver's antenna and induces a current. Figure C-3 shows transmit waves and propagation.

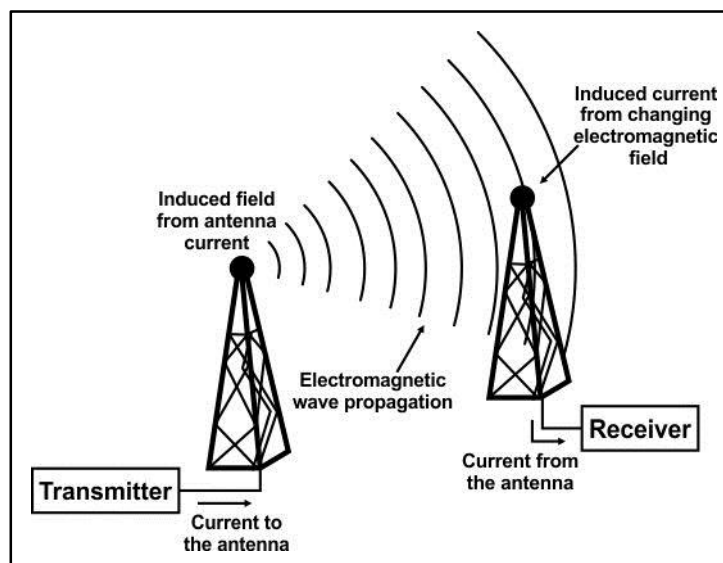


Figure C-3. Transmission and propagation of electromagnetic waves

C-10. Electromagnetic radiation in the area passes across the receiving antenna. To detect and receive the correct signal, the receiving antenna must be able to isolate the desired signal from all others. If the receiver is in range of two transmitters using the same frequency band it is attempting to receive, then the receiver may not properly capture the desired signal for demodulation. The receive signal captured may be unintelligible. The spectrum management process attempts to prevent this situation from occurring. The goal is not to prevent transmitters from using the same frequencies but to ensure that receivers are capable of receiving and distinguishing the desired signals. There may be more than one transmitter using the same carrier frequency as long as the receivers are able to distinguish the desired signal over the others.

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Appendix D

Spectrum Management Lifecycle

The Army spectrum management lifecycle serves as a guide to follow in establishing a functional and efficient spectrum management program. The lifecycle encompasses the complete process of providing spectrum management support to the commander and is applicable to all spectrum managers regardless of duty location. The Army spectrum management lifecycle mirrors the joint task force lifecycle.

SPECTRUM MANAGEMENT LIFECYCLE

D-1. The spectrum management lifecycle consist of 12 activities that enhance SMO. It is not imperative to conduct the lifecycle activities in order as presented. Many spectrum managers conduct activities in the lifecycle simultaneously. Listed below are steps of the spectrum management lifecycle—

1. Define command specific policy and guidance.
2. Gather requirements.
3. Develop electromagnetic spectrum requirements summary.
4. Define the EMOE.
5. Obtain spectrum resource.
6. Develop spectrum management plan.
7. Nominate and assign frequencies.
8. Generate the joint communication-electronic operating instructions.
9. Develop the JRFL.
10. Perform electronic warfare deconfliction.
11. Resolve interference.
12. Report interference.

STEP 1. DEFINE COMMAND SPECIFIC POLICY AND GUIDANCE

D-2. Unit standard operating procedures establish specific guidance for managing, requesting, coordinating, and assigning spectrum use, the JRFL process, communications electronic operating instructions, and other processes. Policy and guidance information should be available in the commander's spectrum guidance, spectrum management manual, command regulations, instructions, or existing plans.

D-3. Spectrum managers require many resources. The unit standard operating procedures would establish the basic spectrum management resources needed to establish a spectrum management element in support of operations anywhere within the commander's operational area. Such resources should include digitized terrain data, background electromagnetic environment records, country area studies, copies of agreements for spectrum use or sharing with involved or adjacent host nations, and historical spectrum use records involving the operational area. This step generates two deliverable products: the spectrum concept and the spectrum requirements data call message.

D-4. The spectrum management concept is the vision of spectrum management operations best practices performed to support the mission. The spectrum management concept comprises assumptions, considerations, and restrictions that, when analyzed together, can illustrate the best approach to managing the EMOE.

D-5. The spectrum requirements data call message provides guidance to staff elements, components, and supporting agencies on how to request spectrum support for spectrum dependent systems that operate under their control within area of influence. This multipart message should cover the following subjects: spectrum management policy and guidance, security classification guidance, frequency and communications electronic operating instructions master net list request procedures, as well as provide guidance for identifying nets and frequencies to be included on the JRFL.

STEP 2. GATHER REQUIREMENTS

D-6. Gathering requirements can begin as soon as spectrum management receives guidance and coordination channels are defined. Spectrum managers must also obtain the requirements of spectrum users, primarily the staff elements. These requirements must address both communications and non-communications such as radar and weapons systems and stated in terms of spectrum requirements to support the command. This step involves undocumented requirements from sources external to the spectrum management coordination chain.

STEP 3. DEVELOP THE SPECTRUM REQUIREMENTS SUMMARY

D-7. This summary quantifies the amount of spectrum necessary to support the command, determine the necessity of using frequency sharing and reuse plans, and help in the development of allotment or channeling plans. This process requires compiling and analyzing the data previously generated. The spectrum manager analyzes the summary and determines the amount of spectrum required. In addition, the spectrum requirements summary determines the number of different radio services competing for spectrum in the same frequency band, determines the different emissions utilizing a particular band, and supports development of a plan for frequency sharing.

D-8. The spectrum requirements summary generated is a compilation of the requirements identified in response to the spectrum requirements data call message. This product is for the sole use of the spectrum manager and provides a tool to base future decisions about efficient spectrum-use and initial requirements definition. This product may assist the spectrum manager in requesting spectrum from a host nation, or to better allocate portions of the spectrum, to support emitters utilizing varying bandwidths.

STEP 4. DEFINE THE EMOE

D-9. Military operations require a common, single, authoritative source for spectrum use information for all friendly, enemy (to the extent available), neutral, and civil emitters and receivers to achieve and manage successful joint spectrum use. This common source of spectrum use information found within the EMOE must be current, accurate, and accessible to authorized users. The spectrum manager is responsible for building and managing this common source of information.

D-10. The EMOE database contains spectrum use information on all friendly military and civilian, available enemy, and neutral forces. Defining the EMOE not only creates a database of frequency assignments, but also identifies factors that affect signal propagation such as environmental characteristics and terrain. This activity starts with defining your operational area and its environmental characteristics, locating necessary terrain data and then locating the data for and creating a database of the known spectrum use information. Defining the EMOE is an ongoing activity. The information produced by this activity provides a baseline database digitally depicting the EMOE and the basis for all spectrum interaction analyses.

STEP 5. OBTAIN SPECTRUM RESOURCES

D-11. Obtain spectrum resources needed to support the command. The spectrum manager coordinates military spectrum use with the spectrum management authority of the host nation or coalition forces involved. The host nation can request spectrum resources for exercises or most military operations other than war. Operations that preclude prior coordination with a host nation, such as forced entry, require the spectrum manager to determine the spectrum resource; evaluation of the background and history of the electromagnetic environment provides support to the spectrum manager. If required, an evaluation of the background environment is essential to establish well-defined spectrum requirements and for the EMOE to remain as up-to-date as possible.

D-12. The spectrum requirements summary can help quantify the amount of spectrum needed and identify the different radio services and emissions that may be operating within each frequency band.

STEP 6. DEVELOP THE SPECTRUM MANAGEMENT PLAN

D-13. Unit standard operating procedures establish specific guidance for managing, requesting, coordinating, and assigning spectrum use and procedures for JRFL and JCEOI processing. Additionally, the spectrum

manager is the focal point for inclusion of spectrum use considerations in the Annex H development and provides administrative and technical support for military spectrum use. This process uses the spectrum management concept, developed in the first activity, along with existing policy and guidance. Other sources of information are lessons learned from previous operations and exercises, the JSC and other spectrum managers.

D-14. The spectrum manager devises a plan to use spectrum resources available. This plan depends upon the products of all the previous activities. Spectrum managers evaluate spectrum management plans for possible improvement on a regular basis. The spectrum management plan is typically included as an appendix to Annex H of an OPLAN or OPORD and evolves from guidance as the operation or exercise transitions from the planning to execution phase.

D-15. The spectrum management plan provides guidance for all spectrum management functions, including information exchange, expected coordination channels, format for deliverable products, interference and reporting resolution procedures, and suggested resolution steps.

STEP 7. NOMINATE AND ASSIGN FREQUENCIES

D-16. Nominate and assign frequencies is the actual implementation of the spectrum management plan. Authority, delegated to components, to issue frequency assignments or allotments provides the maximum latitude and flexibility in support of combat operations. This activity involves the initial assigning of frequencies. The spectrum manager may assign frequencies or delegate (decentralize) assignment authority using frequency pools (allotment plans) provided to functional and service component spectrum managers allowing them to assign frequencies.

D-17. The frequency assignment database, which conforms to and is created based on the table of frequency allocations, radio regulations, and channel plans, is the most important resource the spectrum manager has available and forms the basis for nominating interference free assignments, providing impact analyses of EW operations, and identifying and resolving interference issues.

STEP 8. GENERATE A COMMUNICATIONS-ELECTRONIC OPERATING INSTRUCTIONS

D-18. The CEOI is a two-part document. Part 1 is a directory of radio nets or units and their associated frequencies, call signs, call words, and network identification listed by time period. Part 2 contains supplemental procedures for electronic, visual, and verbal interactions, such as sign or countersigns, obscurants or pyrotechnics and suffix or expanders. CEOI development and distribution is an S-6 or G-6 responsibility and delegated to the spectrum manager.

D-19. The JCEOI provides communications details and information for joint forces, service-specific elements and units including—

- Daily changing and non-changing frequency assignments.
- SINCGARS cue, manual and net identification assignments.
- Call sign assignments.
- Call words assignments.
- Daily changing code words.
- Running passwords.

D-20. Information found in the JCEOI includes document-handling instructions, controlling authority data, effective dates and reproduction instructions. Due to the sensitive information contained in the JCEOI, classification should be at the same level. When jointly used, the Army CEOI becomes the Joint CEOI or JCEOI.

Note. The JCEOI is the most widely used communication control document in any given operational area.

D-21. Overarching regulatory guidance for JCEOI management, to include call signs and call words, is contained within the CJCSM 3320.02, JCEOI publication. Additional guidance may apply based on command relationships with other unified action partners.

D-22. During operations, the combatant commander is the authority for the JCEOI. The combatant commander may delegate this authority, to the ground component commander or the respective joint task force commander. There is a distinction between the air and ground component JCEOI. The relevant air component issues a Special Instructions document that is the air operations equivalent of the JCEOI.

D-23. Within garrison, the Army Command, Army Service component command, or direct reporting unit commander has responsibility for CEOI production and distribution in support of training requirements. U.S. Forces Command may delegate authority to a corps, division or remain centralized to meet installation-training objectives. Regardless of echelon, the commander is responsible for the JCEOI. The J-6 or G-6 develops and promulgates the JCEOI. The J-3 or G-3 validates master net list requirements and resolves conflicts.

Distribution and Development

D-24. The COMSEC facility provides distribution of the final ACES or JACS produced JCEOI product. Doing so ensures all units receive the latest JCEOI with the distribution of COMSEC. Communications cards are derivative products of the JCEOI and are METT-TC driven. Document and protect communications cards in the manner appropriate for their security classification level. These products inherit the classification level of the source JCEOI material.

D-25. When operationally required to maintain administrative tempo with the pace of operations it may be necessary to go without management of the SINCGARS compatible loadset via ACES or JACS and maintain the list of SINCGARS networks using a spreadsheet. ACES or JACS generates the loadset.

Call Words, Call Signs, Suffixes and Expanders

D-26. Call signs and call words establish and maintain communications. They identify the radio stations of command authorities, activities, facilities, units, elements, or individual positions. Call signs do not identify people. Tactical call sign systems meet specific military requirements under an exemption to the International Telecommunications Union radio regulations.

- **Call signs** are a combination of alphanumeric or phonetically pronounceable characters that identifies a communication facility, command, authority, activity, or unit; used primarily for establishing and maintaining communications.
- **Call words** identify units when communicating within a secured communications net. The generation of call words differ based on service component command guidance or directed based off command authority.
- **Suffixes and expanders** further assist in identifying a radio station's position or function. Care in the management of call words ensures that each station sounds phonetically different over voice transport (for example MAD DAWG 6 or MAD DOG 6). Call word usage is for secure networks only.

D-27. Table D-1 provides an explanation of call sign, call word, suffix and expander.

Table D-1. Call signs, call words, suffix and expander

<i>Item Name</i>	<i>Example</i>	<i>Explanation</i>
Call Sign	X6Y24E B9K60H	The term “call sign” refers to the letter-number-letter combination that typically designates a unit element in the CEOI or JCEOI. CJCSI 3320.03A specifies that the call sign should remain daily, changing in the event that the ability to communicate securely is lost. Examples: X6Y= 1/A/1-25 INF (1 st Platoon, A Co., 1-25 INF Bn)
Call Word	Bulldog24E Fury60H	Pronounceable words that identify a communications facility, command, authority, activity or unit; serves the same functionality as the call sign. The Army does not have set call words per unit. Call word deconfliction is typically handled by the highest level spectrum manager. EXAMPLES: Bulldog = 1/a/1-25 INF (1 st Platoon, A Co., 1-125 INF Bn)
Suffix	X6Y24E B9K60H Bulldog24E Fury60H	The term “suffix” refers to the two digits assigned to a particular position, mission or function within a unit or element. EXAMPLES: 24 = AVN Officer/NCO 60 = G-6 or S-6
Expander	X6Y24E B9K60H Bulldog24E Fury60H	A single letter code (A through Z) used in conjunction with a suffix and call sign to identify a sub-element of the position, mission, or function. EXAMPLES: E = NCOIC H = Officer in charge
Legend ACES automated communications engineering software AVN aviation Bn battalion CEOI communications-electronics operating instruction CJCSI Chairman of the Joint Chiefs of Staff Instruction Co company INF infantry JACS joint automated communications-electronics operation instructions system JANAP joint Army, Navy, Air Force publication JCEOI joint communications-electronics operating instructions NCO noncommissioned officer NCOIC noncommissioned officer in charge SOI signal operating instructions		

Security Classification

D-28. The content of the JCEOI, master net list, and communications card extracts determine the classification levels. The level of COMSEC key tag information entered into the system for ACES terminal and corresponding generated loadsets determine the classification. Similar to a classified presentation, the overall classification of a specific product would be the highest level of classification it contains.

Note. See AR 380-5 for security classification markings.

STEP 9. DEVELOP JOINT RESTRICTED FREQUENCY LIST

D-29. The JRFL is a time and geographically oriented listing of functions, nets, and frequencies requiring protection from friendly spectrum users. Developing the JRFL requires the spectrum manager to prepare and combine G-2, G-3, G-6, and component inputs to develop a JRFL for approval by the G-3, and when required, periodically update and distribute the JRFL.

D-30. The JRFL is a G-3 product; it protects communications nets, from enemy communications nets exploitation, and safety of life frequencies used by the command and local civil noncombatants. The development, distribution, and maintenance of the JRFL is a task of the S-6 or G-6 and normally

accomplished by the spectrum manager. Creation of the JRFL is for the CEMA element and based on guidance established by the commander, EWO and the CEMA working group.

D-31. Leaders should become familiar with the types of protection status codes that exist for the JRFL. Knowing these status codes allows the EWO to plan jamming operations on the unrestricted frequencies for training and during operations. Three types of protection status codes apply to frequency assets identified for inclusion in a JRFL. Sample JRFL restriction status codes include—

- **Taboo frequencies:** Taboo frequencies are any friendly frequencies of such importance that they must never be deliberately jammed, interfered with by friendly forces. Normally, these include international distress, safety, stop buzzer, and controller frequencies. These frequencies include international distress, safety, and controller frequencies. They are generally long-standing as well as time-oriented. (JP 3-13.1)
- **Protected frequencies:** Those friendly frequencies used for a particular operation, identified and protected to prevent them from inadvertent jamming by friendly forces while engaged in active EW operations against hostile forces. These frequencies are of such critical importance that jamming should be restricted unless necessary or until coordination with the using unit is made. These frequencies are generally time-oriented, may change with the tactical situation, and updated periodically. Protected frequencies are friendly frequencies used for a particular operation. An example of a protected frequency would be the command net of a maneuver force engaged in the fight. (JP 3-13.1)
- **Guarded frequencies:** Guarded frequencies are those enemy frequencies that maybe currently exploited for combat information and intelligence. Guarded frequencies are time-oriented in that the list changes as the enemy assumes different combat postures. These frequencies may be jammed after the commander has weighed the potential operational gains against the loss of the technical information gained. (JP 3-13.1)

STEP 10. PERFORM ELECTRONIC WARFARE DECONFLICTION

D-32. The S-3 or G-3 EW spectrum manager participates in the CEMA element representing spectrum management issues. This includes providing EW deconfliction analysis. The EWO identifies planned EA missions and request the spectrum manager perform an analysis on the impact of these missions to operations. This process requires information from the JRFL, communications electronic operating instructions, and EMOE. The analysis determines what impact the EA mission has on communication nets, systems, enemy communications nets exploitation, and possible safety of life situations.

D-33. This product provides the CEMA element with an analysis of the potential impact of friendly EW operations on friendly forces. The CEMA element then decides if the benefits of the jamming mission outweigh the dangers of the potential fratricide. This product is time sensitive and produced on an as needed basis.

STEP 11. RESOLVE INTERFERENCE

D-34. Resolving interference is a daily activity once forces have deployed and is part of the planning process. This activity encompasses the reporting and attempting to resolve EMI. Interference maybe created by various factors such as unauthorized users, faulty nomination criteria, lack of timely data exchanges, or equipment problems. Victims of interference should ensure every effort to resolve frequency interference locally. Multiple interference problems may indicate adversary EW operations, unintentional impact of blue or grey EW operations or errors in the spectrum management plan. The spectrum manager should define and analyze the EMOE to help determine the cause of an EMI problem.

STEP 12. REPORT INTERFERENCE

D-35. Spectrum congestion and the nature of military operations make some level of EMI likely. Interference reporting and tracking provides the spectrum manager with a valuable historical reference for resolving future EMI problems. After performing interference analysis, always create an interference report to document the results.

D-36. Keep these reports in a database used as a history of interference problems. The purpose of the interference report database is to provide the spectrum manager with a repository for previous interference incidents and steps taken to resolve them. This database provides a wealth of information on unit discipline, training deficiencies, and a starting place for the spectrum manager to begin resolving interference issues. Spectrum managers share this database with all. To the extent, unexplained interference persists or recurs coincident with either red, blue or grey operations, notification to the CEMA element occurs.

D-37. Spectrum managers must be involved at the onset of interference. Spectrum managers are responsible for resolving and reporting of interference within their responsible area. This includes setting alerts in JSIRO for interference affecting the units operations. They receive notifications by secure email of interference reports submitted for action and situational understanding of the interference. Spectrum managers assist and mitigate spectrum interference at the lowest level possible and should be knowledgeable of all forms of jamming, deception, and interference. Users experiencing EMI may change frequencies only when the spectrum manager coordinates authorized replacement frequencies. Guidance for the JSIR program is contained within the CJCSM 3320.02 series manuals and instructions. Additional procedural guidance in support of the JSIR program may apply based off command relationships such as military departments, Army commands, and combatant commands.

Joint Spectrum Interference Report

D-38. Victims of interference report EMI using JSIRO. JSIRO is a web-based, centralized application containing data and correspondence for reported EMI, intrusion, and jamming incidents. It is the repository for the results of analyses, collected data, and supporting documentation for EMI resolution to support both trend and future interference resolution analysis. JSIRO and CJCSM 3320.02 provide an operator checklist for local investigations.

D-39. EMI is any electromagnetic disturbance that interrupts, obstructs, degrades, or limits the effective performance of electronics and electrical equipment. EMI can be induced intentionally, as in some forms of electronic warfare, or unintentionally, as a result of spurious emissions, responses or intermodulation products.

D-40. EMI mitigation begins with operator-level troubleshooting and reporting. It is imperative that affected users attempt to resolve EMI incidents at the lowest possible level. Troubleshooting may identify the source of the interference as truly EMI or, as in most cases, an equipment or operator failure. Reporting facilitates situational understanding and supports the development of solutions. Report and investigate all prohibitive EMI through the JSIR program. Not all EMI incidents are prohibitive however; prohibitive EMI has an operational impact. Trained equipment operators should identify the difference between prohibitive EMI, equipment failure, and purposeful interference by the adversary. The JSIRO report is submitted through intelligence channels by the appropriate authority if the interfering signal is determined to be from a hostile source,

D-41. The spectrum manager or the victim of interference is responsible for reporting interference using the JSIR format with the information described in table D-2.

Table D-2. Data input for JSIR offline reporting

Item Number	Data Input
1	Frequencies affected by the interference.
2	Locations of systems experiencing the interference.
3	The affected system name, nomenclature, manufacturer (with model number), or other system description. If available, include the equipment characteristics of the victim receiver, such as bandwidth, antenna type, and antenna size.
4	The operating mode of the affected system. If applicable, include the following: frequency agile, pulse Doppler, search, and upper and lower sidebands.
5	The characteristics of the interference (noise, pulsed, continuous, intermittent, frequency, or bandwidth).
6	The description of the interference effects on victim performance (reduced range, false targets, reduced intelligibility, or data errors).

Table D-2, Data input for JSIR offline reporting (continued)

<i>Item Number</i>	<i>Data Input</i>
7	Enter the dates and times the interference occurred. Indicate whether the duration of the interference is continuous or intermittent, the approximate repetition rate of the interference, and whether the amplitude of the interference is varying or constant. Indicate if the interference is occurring at a regular or irregular time of day, and if the occurrence of the interference coincides with any ongoing local activity.
8	The location of possible interference sources (coordinates or line of bearing, if known; otherwise, state as unknown).
9	A listing of other units affected by the interference (if known) and their location or distance, and bearing from the reporting site.
10	Clear and concise narrative summary information about the interference, and any local actions taken to resolve the problem. The operator is encouraged to provide any other information, based on observation or estimation that is pertinent in the technical or operational analysis of the incident. Identify whether the information furnished is an actual observation, measurement or estimate. Avoid the use of Army or program jargon and acronyms.
11	Reference message traffic related to the interference problem reported. Include the message date-time group, originator, action addressees, and subject line.
12	Indicate whether identification or resolution of the problem is completed.
13	Indicate if joint spectrum interference resolution (JSIR) technical assistance is desired or anticipated.
14	Point of contact information, including name, unit, and contact phone numbers.

D-42. The spectrum manager or victim of interference, reports the types of interference signals, the actions used to overcome the interference, the suspected cause and other comments related to the interference signal. Send this report online or forward offline as soon as feasible, based on situation.

Types of Jamming Signals

D-43. Jamming is an effective way for the adversary to disrupt mission command. All the adversary needs to jam is a transmitter tuned to our frequency with enough power to override friendly signals at our receivers. There are two modes of jamming. Spot jamming is concentrated power directed toward one channel or frequency. Barrage jamming is power spread over several frequencies or channels at the same time.

D-44. Jamming can be difficult, and sometimes impossible to detect. Users of spectrum devices have the potential of being jammed and should be able to recognize jamming. The two types of jamming most commonly encountered are obvious and subtle jamming. Obvious jamming is normally very simple to detect. When experiencing a jamming incident, it is more important to recognize and overcome the incident than to identify it formally. The spectrum manager or victim reports the type of jamming signal during the JSIR process. The more commonly used jamming signals of this type are—

- **Random noise.** This is synthetic radio noise. It is random in amplitude and frequency. It is similar to normal background noise and can degrade all types of signals. Operators often mistake it for receiver or atmospheric noise and fail to take appropriate actions.
- **Stepped tones.** These are tones transmitted in increasing and decreasing pitch. They resemble the sound of bagpipes. Single-channel voice circuits are normally the victims of stepped tones.
- **Spark.** The spark signal produces the most easily and effective type of jamming. Bursts are of short duration and high intensity. Spark jamming signals, repeated at a rapid rate, is effective in disrupting all types of radio communications.
- **Gulls.** The gull signal is a quick rise and slow fall of a variable radio frequency and is similar to the cry of a sea gull. It produces a nuisance effect and is very effective against voice radio communications.
- **Random pulse.** In this type of interference, pulses of varying amplitude, duration, and rate are generated and transmitted. They disrupt teletypewriter, radar, and various types of data transmission systems.
- **Wobbler.** The wobbler signal is a single frequency modulated by a low and slowly varying tone. The result is a howling sound that causes a nuisance effect on voice radio communications.

- **Recorded sounds.** Recorded sounds are any audible sound, especially of a variable nature, to distract radio operators and disrupt communications. Music, screams, applause, whistles, machinery noise, and laughter are examples of recorded sounds jamming.
- **Preamble jamming.** This type of jamming occurs when a broadcast resembling the synchronization preamble speech of security equipment over the operating frequency of secure radio sets. Preamble jamming results in all radios being locked in the receive mode. It is especially effective when employed against radio nets using speech security devices.
- **Subtle jamming.** Subtle jamming is not obvious; no sound from the receiver radio. The radio cannot receive the intended incoming signal, even though everything appears normal to the radio operator. In effect, the threat jammers block out these radios' ability to receive a friendly transmission without the operator being aware it is happening. This is squelch capture and is a subtle jamming technique. The radio operator can readily detect jamming in all other function control modes. Often, we assume that our radios are malfunctioning instead of recognizing subtle jamming for what it is.

Recognizing Jamming

D-45. Equipment operators must be able to recognize jamming. Threat jammers may employ obvious or subtle jamming techniques. In addition, interference caused by sources having nothing to do with adversary jamming may be the source. Jammers affect receivers and do not affect transmitters.

D-46. Prohibitive EMI may be caused by the following—

- Unintentionally by other radios (friendly and enemy).
- Other electronic or electric or electromechanical equipment.
- Atmospheric conditions.
- Malfunction of the radio.
- Improper operation of the radio.
- Combination of any of the above.

D-47. **Internal or external interference.** The two sources of interference are internal and external. If the interference or suspected jamming remains after grounding or disconnecting the antenna, the disturbance is most likely internal and caused by a malfunction of the radio. Contact maintenance personnel to assist in troubleshooting. Further examinations could reveal external interference from adversary jamming or unintentional interference.

D-48. **Jamming or unintentional interference.** Causes of unintentional interference include other radios, some other type of electronic or electromechanical equipment, or atmospheric conditions. The battlefield is so crowded with radios and other electronic equipment that some unintentional interference is virtually unavoidable. Static electricity produced by atmospheric conditions can negatively affect radio communications. Unintentional interference normally travels only a short distance and a search of the immediate area may reveal the source of this type of interference. Moving the receiving antenna for short distances may cause noticeable variations in the strength of the interfering signal. These variations normally indicate unintentional interference. Conversely, little or no variation may indicate inadvertent friendly or adversarial jamming. Regardless of the source, take actions to reduce the effect of interference on our communications.

D-49. In all cases, report suspected adversary jamming and any unidentified or unintentional interference that disrupts our ability to communicate. This applies even if the radio operator is able to overcome the effects of the jamming or interference. Information provided to higher headquarters in the JSIR report mitigates the adversary jamming efforts.

D-50. The adversary can use two types of jamming signals: powerful un-modulated or noise-modulated signals. Un-modulated jamming signals lack any noise and noise modulated jamming signals have obvious interference noises.

Overcoming Jamming

D-51. The adversary constantly strives to perfect and use new and more confusing forms of jamming. Our equipment operators must be increasingly alert to the possibility of jamming. Training and experience are the most important tools operators have to determine when a particular signal is a jamming signal. Exposure to the effects of jamming in training or actual situations is invaluable. The ability to recognize jamming is important, because jamming is a problem that requires action.

D-52. Continue to operate if jamming does occur. Usually, adversarial jamming involves a period of jamming followed by a brief listening period. The adversary is attempting to determine how effective jamming has been. What the victim is doing during this short period when listening, tells the jammer how effective jamming has been. If the operation is continuing in a normal manner, as it was before the jamming began, the enemy assumes that jamming has not been particularly effective. If the adversary finds users discussing the jamming over the radio or shut down our operation entirely, the adversary may very well assume that jamming has been effective. Because the enemy jammer is monitoring operations, unless otherwise ordered, never shut down operations or in any other way disclose to the enemy that you may be adversely affected. Normal operations should continue even when degraded by jamming.

Improve the Signal-to-Jamming Ratio

D-53. The signal-to-jamming ratio is the relative strength of the desired signal to the jamming signal at the receiver. Signal refers to the frequency users are attempting to receive. Jamming refers to the hostile or unidentified interference received. A signal-to-jamming ratio in which the desired signal is stronger than the jamming signal cannot significantly degrade the desired signal.

D-54. Users experiencing jamming may take a variety of steps to improve the signal-to-jamming ratio. Adjust the receiver and ensure frequency tuning is as precise as possible to the desired incoming signal to improve the signal-to-jamming ratio. Additional techniques to improve signal-to-jamming ratio include—

- Adjusting the radio frequency bandwidth.
- Adjusting the gain or volume control.
- Fine-tuning the frequency.
- Increasing the transmitter power output.

D-55. Increasing the power output of the transmitter emitting the desired signal improves the signal-to-jamming ratio. To increase the power output at the time of jamming, the transmitter must be set on something less than full power when jamming begins. Using low power as a preventive technique depends on the adversary not being able to detect radio transmissions. Once the adversary begins jamming radios, the threat of being detected increases.

D-56. Users experiencing jamming should ensure antennas are optimally adjusted to receive the desired incoming signal. Additional techniques to improve receive signal strength regarding antenna include—

- Reorienting the antenna.
- Changing the antenna polarization. (Perform this action at all stations.)
- Installing an antenna with a longer range (higher gain).

D-57. **Relocate the antenna.** Frequently, the signal-to-jamming ratio maybe improved by relocating the antenna and associated radio set affected by the jamming or unidentified interference. This may mean moving a few meters or several hundred meters. It is best to relocate the antenna and associated radio set to an area that has a terrain feature between the user and any suspected enemy jamming location.

D-58. **Establish a retransmission station.** A retransmission station can increase the range and power of a signal between two or more radio stations. Depending on the available resources and the situation, this may be a viable method to improve the signal-to-jamming ratio.

D-59. **Use an alternate route for communications.** In some instances, enemy jamming prevents us from communicating with a radio station with which we must communicate. If radio communications have degraded between two radio stations that must communicate, there may be another radio station or route of communications that can communicate with both of the radio stations. Use the alternate radio station or route as a relay between the two other radio stations.

D-60. Change frequencies. If a communications net cannot overcome adversarial jamming using the above measures, the commander (or designated representative) may direct the net to switch to an alternate or spare frequency coordinated through your spectrum manager. If practical, dummy stations can continue to operate on the frequency being jammed to mask the change to an alternate frequency. Frequency changes that are preplanned result in minimal communications loss. During adversarial jamming, it is very difficult to coordinate a change of frequency.

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Appendix E

Military Time Zone Designators

Spectrum managers provide support for the EMOE in support of unified action partners. Spectrum managers communicate with users across different time zones and provide commanders with operational times established during missions. Support to airborne operations provides the widest use of military time zones during flight missions. Knowledge of global military time zone differences for spectrum managers is a vital skill. Spectrum managers may be called upon to prepare briefings, conduct and assist planning or provide input to critical documents, accurate time zone information is essential.

OVERVIEW

E-1. Military time uses the 24-hour clock beginning at midnight (0000 hours) and ending at 2359 hours. Military time format eliminates the need for using A.M. and P.M. designations as regular time uses numbers 1 to 12 to identify the hours in a day. In Military time 12 P.M. is 1200 hours, 1 P.M. is 1300 hours up until 11 P.M. where it is 2300 hours. The military uses this standard as it leaves less room for confusion than standard time. The world is divided into 24 military time zones and each military zone has a letter designation and the military phonetic alphabet word.

E-2. The time zone for Greenwich, England is the letter “Z” and the military phonetic word is “Zulu”. Since many U.S. military operations must be coordinated across times zones, the military uses Coordinated Universal Time (formerly Greenwich Mean Time) as the standard time. The U.S. Military refers to this as Zulu (Z) time and attaches the suffix to ensure the referred time zone is clear.

E-3. When referring to specific military time zones, speak the letter or word attached. As an example, if a military exercise began at 3:00 P.M. Zulu time; or “fifteen hundred hours Zulu time” and written as 1500Z.

E-4. The time zones from the U.S. are Romeo, Sierra, Tango, Uniform, Victor, Whiskey, X-Ray. Local time uses the letter J or Juliet. Written format for 9 A.M. local time is 0900J and spoken as “Zero 900 hours Juliet time.” The Lima time zone designator does not equate to local time. See Time Zone chart for the location of Lima time zone.

E-5. Some countries have a 15, 30, or 45-minute offset from the designated time zone designator. Although located in the Delta time zone, Juliet time in Afghanistan is Coordinated Universal Time +4 hours 30 minutes. An asterisk behind the affected time zone designator denotes that a Juliet offset is in effect. See Time Zone Chart for affected regions. This offset is recorded as 0430D* or 190430RDEC13* within a Date Time Group.

Military Time Zone Considerations

E-6. While conducting military operations, spectrum managers must consider all rules for determining a specific time. The following are some consideration to be aware of—

- The military observes daylight savings time when recognized by the state or country.
- The 12 time zones west of the Zulu time zone (coordinated universal time), starting from the International Date Line and ending in the Pacific Ocean are November through Yankee.
- The 12 time zones east of the Zulu time zone (coordinated universal time), starting at the International Date Line and ending in the Pacific Ocean are Alpha through Mike.
- 12 A.M. can be both 0000 and 2400 hours. However, clocks that display military time always display it as 0000.

E-7. Many countries use military time as their main time format. European, African, Asian, and Latin American countries commonly use military time as their main time format. In some countries, both the 12 and 24-hour clock are used. Figure E-1 shows the world map and military zone designators for each zone.

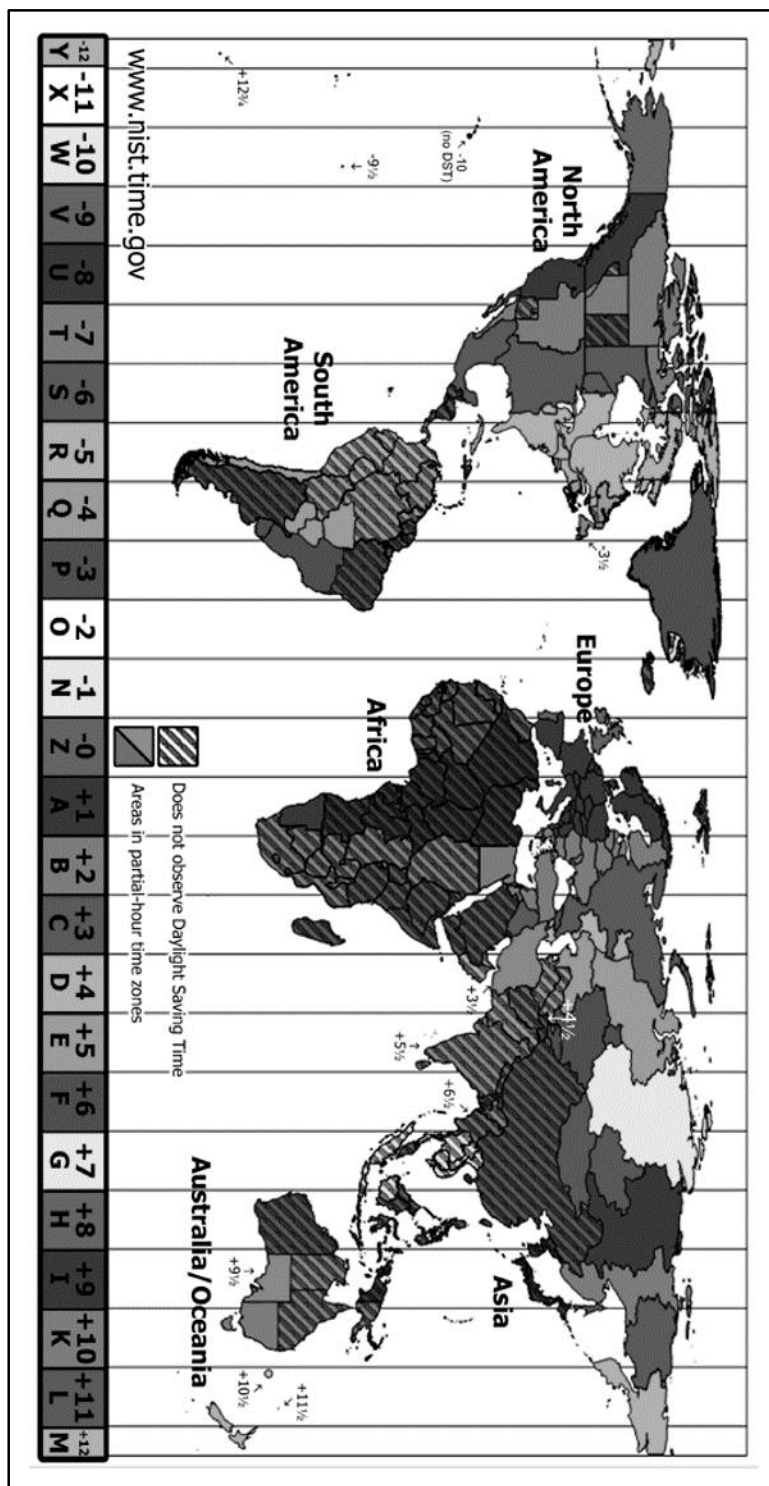


Figure E-1. World military time zone designator chart

E-8. Table E-1 outlines each time zone around the world and provides its relationship to Zulu time.

Table E-1. Example of world time zone conversion (standard time)

Military Time Zone Designators																									
Y	X	W	V	U	T	S	R	Q	P	O	N	Z	A	B	C	D	E	F	G	H	I	K	L	M	
Civilian Time Zones																									
IDLW	NT	HST	ASDT	PST	MST	CST	EST	AST	NST	AT	WAT	UTC	CET	EET	BT	ZP4	ZP5	ZP6	WAST	CCT	JST	GST	SBT	IDLE	
1200	1300	1400	1500	1600	1700	1800	1900**	2000	2100	2200	2300	2400	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200*	
Standard Time=Universal Time + Value from Table																									
Z		0		E		+5		K		+10		P		-3		U		-8							
A		+1		F		+6		L		+11		Q		-4		V		-9							
B		+2		G		+7		M		+12		R		-5		W		-10							
C		+3		H		+8		N		-1		S		-6		X		-11							
D		+4		I		+9		O		-2		T		-7		Y		-12							
* =Today ** =Yesterday																									
Legend																									
ASDT-Alaska Standard Time										EST-Eastern Standard time										PST-Pacific Standard Time					
AST-Atlantic Standard Time										GST-Guam Standard Time										SBT-Solomon Island Time					
AT-Azores Time										HST-Hawaii Standard Time										UTC-Coordinated Universal Time					
AWST-Australian Western Standard Time										IDLE-International Date Line East										WAST-West Africa Time Zone					
BT-Baghdad										IDLW-International Date Line West										WAT-West Africa Time					
CCT-China Coast Time										JST-Japan Standard Time										ZP-4 Azerbaijan, Oman, Mauritius					
CET-Central European Time										NST-Mountain Standard Time										ZP-5 Maldives, Pakistan, Tajikistan					
CST-Central Standard Time										NST-Newfoundland Standard Time										ZP-6 Bangladesh, Kazakhstan					
EET-Eastern European Time										NT-Nome Time															

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Glossary

The glossary lists acronyms and terms with Army or joint definitions. Where Army and joint definitions differ, (Army) precedes the definition. The proponent publication for terms is listed in parentheses after the definition. This publication is not the proponent for any terms.

SECTION I – ACRONYMS AND ABBREVIATIONS

ACES	automated communications engineering software
AESOP	Afloat Electromagnetic Spectrum Operations Program
CEMA	cyber electromagnetic activities
CJCSM	Chairman of the Joint Chiefs of Staff manual
CJSMPT	Coalition Joint Spectrum Management Planning Tool
COA	course of action
COMSEC	communications security
COP	common operational picture
CSV	comma separated values
DA	Department of the Army
DD	Department of Defense
DOD	Department of Defense
EA	electronic attack
EP	electronic protection
EMI	electromagnetic interference
EMOE	electromagnetic operational environment
EW	electronic warfare
EWO	electronic warfare officer
G-2	assistant chief of staff for intelligence
G-3	assistant chief of staff, operations
G-6	assistant chief of staff, signal
G-7	assistant chief of staff, information engagement
GEMSIS	Global Electromagnetic Spectrum Information System
GHz	gigahertz
HERF	hazards of electromagnetic radiation to fuels
HERO	hazards of electromagnetic radiation to ordnance
HERP	hazards of electromagnetic radiation to personnel
HN	host nation
HNSWDO	Host Nation Spectrum Worldwide Database Online
Hz	Hertz
J-3	operations directorate of a joint staff
J-6	communications system directorate of a joint staff
JACS	joint automated communications electronics operation instructions system
JCEOI	joint communications-electronics operating instructions

JFMO	joint frequency management office
JRFL	joint restricted frequency list
JSC	joint spectrum center
JSIR	joint spectrum interference resolution
JSIRO	joint spectrum interference resolution online
JSME	joint spectrum management element
kHz	kilohertz
MANCAT	multi spectral ambient noise collection and analysis tool
MCEB	Military Communications-Electronics Board
MDMP	military decisionmaking process
MHz	megahertz
NCE	network-centric environment
NG	National Guard
NIPRNET	Nonsecure Internet Protocol Router Network
NTIA	National Telecommunications and Information Administration
OPLAN	operation plan
OPORD	operation order
RF	radio frequency
S-2	battalion or brigade intelligence staff officer
S-3	battalion or brigade operations staff officer
S-6	(Army) battalion or brigade signal staff officer
S2AS	Spectrum Situational Awareness System
SDD	spectrum dependent devices
SFAF	standard frequency action format
SINCGARS	single-channel ground and airborne radio system
SIPRNET	SECRET Internet Protocol Router Network
SMO	spectrum management operations
SOI	signal operating instructions
SPEED	systems planning, engineering, and evaluation device
SSRF	standard spectrum resource format
XML	extensible markup language

SECTION II – TERMS

cyber electromagnetic activities

Activities leveraged to seize, retain, and exploit an advantage over adversaries and enemies in both cyberspace and the electromagnetic spectrum, while simultaneously denying and degrading adversary and enemy use of the same, and protecting the mission command system. (ADRP 3-0)

direction finding

(joint) A procedure for obtaining bearings of radio frequency emitters by using a highly directional antenna and a display unit on an intercept receiver or ancillary equipment. (JP 1-02)

electromagnetic environmental effects

(joint) The impact of the electromagnetic environment upon the operational capability of military forces, equipment, systems, and platforms. Also called E3 (JP 1-02)

electromagnetic interference

(joint) Any electromagnetic disturbance, induced intentionally or unintentionally, that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics and electrical equipment. Also called EMI (JP 1-02)

electromagnetic operational environment

(joint) The background electromagnetic environment and the friendly, neutral, and adversarial electromagnetic order of battle within the electromagnetic area of influence associated with a given operational area. Also called EMOE. (JP 6-01)

electromagnetic spectrum

(joint) The range of frequencies of electromagnetic radiation from zero to infinity. It is divided into 26 alphabetically designated bands. Also called EMS. (JP 1-02)

electromagnetic spectrum control

(joint) Coordinated execution of joint electromagnetic spectrum operations with other lethal and nonlethal operations that enable freedom of action in the electromagnetic operational environment (JP 3-13.1)

electromagnetic spectrum management

(joint) Planning, coordinating, and managing joint use of the electromagnetic spectrum through operational, engineering, and administrative procedures. (JP 6-01)

electronic warfare

(joint) Military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy. Also called EW. (JP 3-13.1)

electronic attack

(joint) Division of electronic warfare involving the use of electromagnetic energy, directed energy, or antiradiation weapons to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability and is considered a form of fires. Also called EA. (JP 3-13.1)

electronic protection

(joint) Division of electronic warfare involving actions taken to protect personnel, facilities, and equipment from any effects of friendly or enemy use of the electromagnetic spectrum that degrade, neutralize, or destroy friendly combat capability. Also called electronic protection. (JP 3-13.1)

electronic warfare support

(joint) Division of electronic warfare involving actions tasked by, or under the direct control of, an operational commander to search for, intercept, identify, and locate or localize sources of intentional and unintentional radiated electromagnetic energy for the purpose of immediate threat recognition, targeting, planning, and conduct of future operations. Also called ES. (JP 3-13.1)

frequency allocation

An entry in the table of frequency allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned. (NTIA Redbook)

frequency allotment

An entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions. (NTIA Redbook)

frequency assignment

The authorization given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions. (NTIA Redbook)

frequency deconfliction

(joint) A systematic management procedure to coordinate the use of the electromagnetic spectrum for operations, communications, and intelligence functions. Frequency deconfliction is one element of electromagnetic spectrum management. (JP 1-02)

frequency proposal

(joint) A proposed frequency assignment which is in the approval process (upon approval it becomes a frequency assignment). (MCEB Pub 8)

guarded frequencies

(joint) A list of time-oriented, enemy frequencies that are currently being exploited for combat information and intelligence or jammed after the commander has weighed the potential operational gain against the loss of the technical information. (JP 1-02)

host nation

(joint) A nation which receives the forces, supplies of allied nations or North Atlantic Treaty Organization organizations to be located on, to operate in, or to transit through its territory. Also called HN. (JP 1-02)

joint electromagnetic spectrum operations

(joint) Those activities consisting of electronic warfare and joint electromagnetic spectrum management operations used to exploit, attack, protect, and manage the electromagnetic operational environment to achieve the commander's objectives. Also called JEMSO. (JP 1-02.)

joint restricted frequency list

(joint) A time and geographically oriented listing of TABOO, PROTECTED, and GUARDED functions, nets, and frequencies and limited to the minimum number of frequencies necessary for friendly forces to accomplish objectives. Also called JRFL. (JP 1-02)

joint spectrum interference resolution

(joint) is a process designed to mitigate or define the procedures to mitigate Electromagnetic interference (EMI) that regularly hampers the mission command of military or non-military operations by degrading essential systems that use the electromagnetic spectrum. Since EMI can be caused by enemy, neutral, friendly, or natural sources, it generally must be resolved on a case-by-case basis. The intent of the JSIR procedures (CJCSM 3320.02D) is to mitigate EMI incidents at the lowest possible level within the command structure. However, when the cause and recipient of the interference are not within the same component force or supporting element, resolution may require assistance from the combatant command, joint task force (JTF), Service Spectrum Management Headquarters or higher levels of authority. Also called JSIR. (MCEB Pub 8)

military decisionmaking process

An interactive planning methodology to understand the situation and mission, develop a courses of action, and produce an operation plan or order. (ADP 5-0)

protected frequencies

(joint) Friendly, generally time-oriented, frequencies used for a particular operation, identified and protected to prevent them from being inadvertently jammed by friendly forces while active electronic warfare operations are directed against hostile forces. (JP 1-02)

spectrum management operations

The interrelated functions of spectrum management, frequency assignment, host nation coordination, and policy that together enable the planning, management, and execution of operations within the electromagnetic operational environment during all phases of military operations. Also called SMO. (FM 6-02)

standard frequency action format

(joint) used for DOD radio frequency proposals, assignments, modifications, renewals, reviews, and deletions. Will be replaced by the standard spectrum resource format. Also called SFAF. (MCEB Pub 7)

standard spectrum resource format

(joint) is a format for exchanging data related to spectrum management within the DOD. Will replace the Standard Frequency Action Format. Also called SSRF. (MCEB Pub 8)

TABOO frequencies

(joint) Any friendly frequency of such importance that it must never be deliberately jammed or interfered with by friendly forces including international distress, safety, and controller frequencies. (JP 1-02)

unified action partners

Those military forces, governmental and nongovernmental organizations, and elements of the private sector with whom Army forces plan, coordinate, synchronize, and integrate during the conduct of operations. (ADRP 3-0)

warfighting function

A group of tasks and systems (people, organizations, information, and processes) united by a common purpose that commanders use to accomplish missions and training objectives. (ADRP 3-0)

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References

REQUIRED PUBLICATIONS

Most joint publications are available online: www.dtic.mil/doctrine/new_pubs/jointpub.htm.

These documents must be available to intended users of this publication.

ADRP 1-02. *Terms and Military Symbols*. 7 December 2015.

JP 1-02. *Department of Defense Dictionary of Military and Associated Terms*. 8 November 2010.

RELATED PUBLICATIONS

These documents contain relevant supplemental information.

JOINT PUBLICATIONS

Most joint publications are available online: <http://www.dtic.mil/doctrine>.

CJCSM 3320.01C. *Joint Electromagnetic Spectrum Management Operations in the Electromagnetic Operational Environment*. 14 December 2012.

CJCSM 3320.02D. *Joint Spectrum Interference Resolution (JSIR) Procedures*. 3 June 2013.

JP 3-13.1. *Electronic Warfare*. 8 February 2012.

JP 3-28. *Defense Support of Civil Authorities*. 31 July 2013

JP 6-01. *Joint Electromagnetic Spectrum Management Operations*. 20 March 2012.

MCEB Pub 7. *Standard Frequency Action Format (SFAF)*. 20 November 2012.

MCEB Pub 8. *Standard Spectrum Resource Format (SSRF)*. 4 April 2012.

ARMY PUBLICATIONS

Most Army doctrinal publications and regulations are available online: <http://www.apd.army.mil>.

ADP 3-0. *Unified Land Operation*. 10 October 2011.

ADP 5-0. *The Operations Process*. 17 May 2012.

ADRP 3-0. *Unified Land Operations*. 16 May 2012.

ADRP 3-28. *Defense Support of Civil Authorities*. 14 June 2013.

AR 5-12. *Army Use of the Electromagnetic Spectrum*. 15 February 2013.

AR 380-5. *Department of the Army Information Security Program*. 29 September 2000.

ATP 3-36. *Electronic Warfare*. 16 December 2014.

FM 3-38. *Cyber Electromagnetic Activities*. 12 February 2014.

FM 6-0. *Commander and Staff Organization and Operations*. 05 May 2014.

FM 6-02. *Signal Support to Operations*. 22 January 2014.

FM 27-10. *The Law of Land Warfare*. 18 July 1956.

OTHER PUBLICATIONS

National Telecommunications and Information Administration Redbook. *Manual of Regulations and Procedures for Federal Radio Frequency Management*. May 2013 found online at the following: <http://www.ntia.doc.gov/osmhome/redbook/redbook.html>.

Title 10 of the United States Code. *Armed Forces*.

Title 32 of the United States Code. *National Defense*.

Title 47 of the United States Code. *Telecommunication*.

<http://uscode.house.gov/>.

International Telecommunication Union Radio Regulations. Edition of 2008.

PRESCRIBED FORMS

None.

REFERENCED FORMS

Unless otherwise indicated, DA Forms are available on the Army Publishing Directorate (ADP) website: www.apd.army.mil.

DA Form 2028. *Recommended Changes to Publications and Blank Forms*.

DD Forms are available on the Office of the Secretary of Defense (OSD) web site: www.dtic.mil/whs/directives/infomgt/forms/formsprogram.htm.

DD Form 1494. *Application for Equipment Frequency Allocation*.

WEBSITES

Acquisition Community Connection.

<https://acc.dau.mil/CommunityBrowser.aspx?id=18002&lang=en-US>.

Spectrum XXI overview. http://www.disa.mil/jsc/pdf/SPECTRUMXXI_JSC.pdf.

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ATP 6-02.70
31 December 2015

By Order of the Secretary of the Army:

MARK A. MILLEY
General, United States Army
Chief of Staff

Official:

A handwritten signature in black ink, appearing to read "Gerald B. O'Keefe". The signature is stylized with a large initial "G" and a prominent "B".

GERALD B. O'KEEFE
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